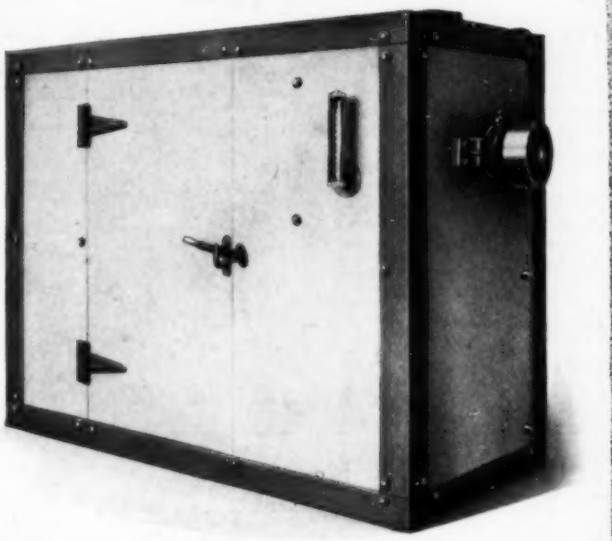
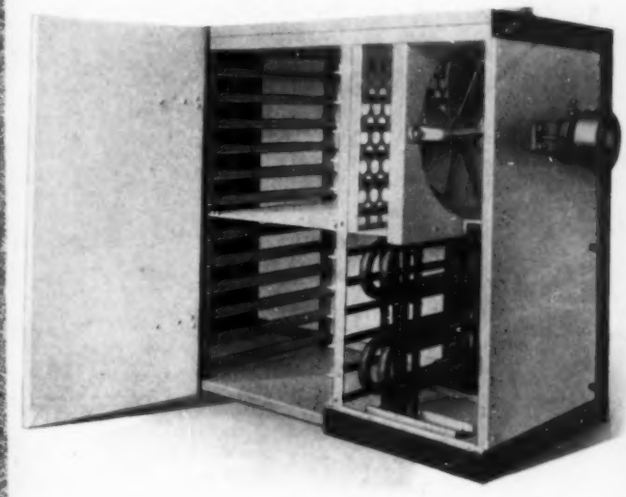
CHEMICAL & METALLURGICAL ENGINEERING

McGraw-Hill Co., Inc. September 21, 1921 25 Cents Per Copy





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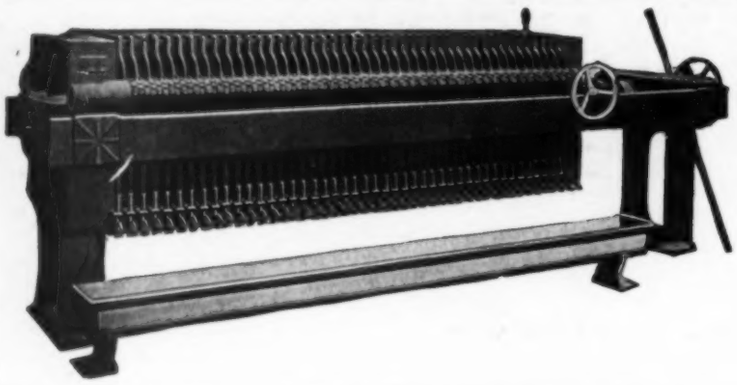
TRAY-TYPE DRYER



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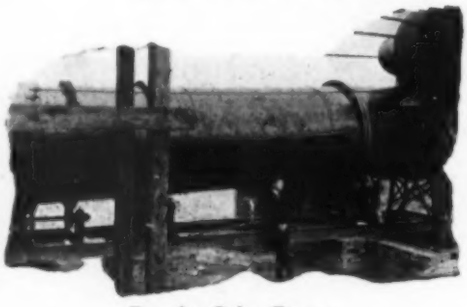

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Ruggles-Coles Engineering Company
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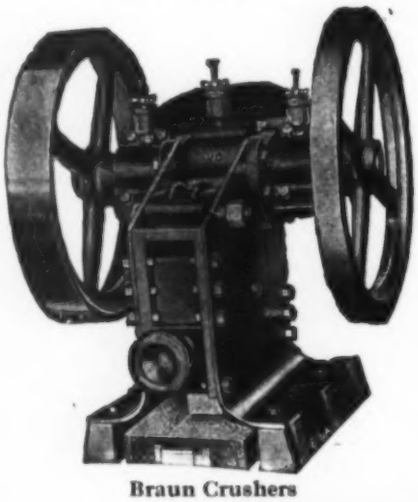

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A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

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Volume 25 — New York, September 21, 1921 — Number 12

Sixty-second Meeting of The American Chemical Society

THE sixty-second meeting of the American Chemical Society is over, and it may be described as a good one. Under the distinguished presidency of Dr. EDGAR FAHS SMITH it was bound to have quality. The man at the head is certain to give tone to what he directs, and the Provost Emeritus is of the Blood Royal of Good Fellowship. It could not be a commonplace meeting, although it bore none of the hallelujah appellations so dear to the hearts of the scare-head writers. It did not suffer from being a "Get Together" or a "Press Onward" meeting. It was just the sixty-second meeting, and excellent of its kind.

There were 334 papers presented before the various divisions, and that was, of course, too many. One can get "fed up" on almost any subject, and we are of the opinion that fewer papers and livelier discussions would do more to speed the gospel of chemistry and the enlightenment that goes with it than more papers and less talk. Perhaps if, after every fifty minutes, a recess of ten minutes were taken it would give those present a chance to stretch their legs and get a breath of fresh air. After several hours of miscellaneous listening one gets tired and classroom-worn. He misses points, and if he is tired enough he will agree tentatively by saying nothing when his chemical conscience should have prompted him to protest, or to oppose that with which he does not agree.

The international meeting in the Great Hall of the City College was an occasion of leading importance, and the papers were full of meat. But this also was too long. To listen to papers, even of such rare merit as these, from 2:30 until after 5 o'clock is too much. It was like a Gothic festival: so bounteous as to paralyze.

On the whole the meeting was an important scientific achievement. Our only criticism is a call for reorganization of the method of presenting papers. We think a little closer association of division chairmen might bring about a correction of this weariness factor. As the meetings are now conducted the incidence of weariness is too early; it comes long before the sessions are over.

Is It Dyes, Dyers, Ignorance or Cupidity?

ON THE afternoon of September 13 there was called an informal meeting in the clubrooms of the United Waist League of America, to discuss problems and troubles relating to dyes and dyed goods. Curiously enough—for such is the mutability of space!—this association of manufacturers of ladies' ready-made waists occupies the former habitation of the learned Grolier Club, and in the very apartment where the discussion took place there were erstwhile disputes as to first editions of Junius, exhibitions of renaissance bindings, second folios of Shakespeare, and, if we remember aright, it was there that we saw for the first time a Breeches Bible. Who dares deny that time is a dimension of space?

On September 13, however, the discussion was far more direct and to the point than is the habit of bibliophiles in their arguments. Manufacturers of garments are having trouble with dyed goods today, and some complained that the quality was worse than ever before. One of the principal complaints was of black silks and navy blues. Another frequent trouble was with "bisque," a light shade of tan. Others reported difficulty in getting desired results in woolen goods. If producers of cotton goods were present, they were less audible than the others. Mr. MOSESSOHN, the chairman, explained the difficulty: they buy the materials, make them up into garments, and then complaints come in. Thereupon they endeavor to trace the source of trouble, and there follows a manifestation of "passing the buck" that leaves the garment manufacturer bewildered and no wiser than he was before. He doesn't get anywhere when he tries to find out.

The desire was generally expressed, except by a few silent representatives of importers of German dyes, that the American dye industry be maintained, and the statement was made that the fault does not lie in American-made products. It was soon made clear that black silks, for instance, should be dyed with logwood, and that there is no shortage of that material nor any novelty in applying it. The delicate, light shades, it was declared, never had been fast, and against this was reported a claim by one establishment that it had developed a new process that makes "bisque," for instance, reasonably fast to light and wash—if the water is not too hot.

A complaint about blue bathing suits brought out the fact that the goods had been dyed with a perfectly good color—for other purposes—but that the medium used was not and never had been fast to light, salt water and perspiration.

This brought out the fact that very often the dyer does not know what the goods are to be used for. Fastness is a relative term. No dye ever was or ever will be absolutely fast. Yarn for bathing suits requires different dyes and treatment from yarn for dress goods. Black stockings—at least in the good old days when we were young—did not have to be made fast to light.

A gentleman of large experience said that in the past eight or nine years a large number of so-called dyers had sprung up in this country who are not dyers at all; they are painters.

Mr. BLUM of the United Piece Dye Works, who speaks with unquestioned authority, said that 90 per cent of the dyes we had before the war are made here, and the remaining 10 per cent can be obtained under license. The fault, he said, does not lie with the American-made products. Every trouble in dyeing has its specific

cause, and the number of them is legion. We are likely to forget that 1914 was nearly eight years ago, and that many classes of goods were as unreliable then as they are now. Mr. LEE, of the National Vigilance Committee, said that, what with high prices and buyers' strikes, the public had a grouch, and was disposed to blame the profiteer if anything was wrong. Dr. MATTHEWS, of the *Color Trade Journal*, struck the keynote when he said that goods should be dyed for quality rather than for price.

The meeting concluded with the appointment of a strong committee of textile chemists, dyers and manufacturers of garments to take up each complaint, trace each piece of goods through its history and find out what is wrong. That will bring out the fault and indicate just where it lies. It will show up incompetent dyers and put the blame on the man who skimped his work, no matter who he be, and whether the cause were due to the strain of economy, ignorance of conditions that should have been understood, lack of right dye or use of wrong one, or downright incapacity.

We have nothing to take back of what we said lately about the trouble with dyed goods.

Further Defense of The Selective Embargo

ONE of the arguments sometimes urged against the selective embargo feature of the dye bill is that it is a legislative experiment and entirely revolutionary in nature. In answer to these objections most of us have been content to emphasize the fact that the unusual character of the present emergency and the vital importance of the dye industry call for a new and unusual sort of legislative treatment. We have felt, however, that this answer was not always convincing and we are very grateful, therefore, to the good friend who has called to mind a rather striking parallel of the dye bill. Think back for a moment to the recent immigration law. Is it not of exactly the same nature as the selective embargo? American labor found itself out of employment and the few existing jobs were threatened by an influx of cheap labor from abroad. Foreign countries were preparing to dump their surplus population on this country. Did we permit them to do it? No; the zealous safeguards of labor were on the job and quickly devised a careful plan for the restrictive control of immigration. At first we were frankly skeptical of the measure and not altogether sure that it was right in principle, but we are ready to admit that as far as our observation goes the embargo on immigration has contributed much to the common good.

Certainly the case of the dye industry has been so carefully and completely presented that it is scarcely necessary for us to vouch for the validity of its claims. The heads of our military establishments have told us that a dye industry is not only a helpful adjunct in the prosecution of modern warfare but is absolutely essential to the national defense. Economists have shown it to be a key industry upon whose products the employment of millions is dependent. The medical fraternity relies upon it for the medicinals vital to our health and happiness, and finally our universities and colleges—in fact the science of chemistry itself—cannot progress if this industry is stifled. When so much is at stake, why should we hesitate? The welfare of the nation will be served by the selective embargo on dyes, and certainly it is no more revolutionary than much of our present law.

A number of similar precedents can be found even in the existing tariff schedules. The Department of Agriculture, for example, can place an absolute embargo on foods which fail to meet the standards of the pure food and drugs act. Potatoes, grain, farm animals, pets, foreign drugs, vaccines and serums and many other articles can be imported only under strictest quarantine which in many cases amounts to a practical embargo. Are these commodities more inimical to the good of the country than are the products purposely intended to destroy our dye industry? We think not.

Mr. Ford's Offer For Muscle Shoals

LOOKING backward into the history of the notorious Muscle Shoals project, the fact stands out that there has been a deliberate confusing of the public mind in connecting the manufacture of nitrates with water-power development on the Tennessee River. Private interests desiring to enrich themselves at the expense of the Federal Government and politicians seeking forced economic development in one small section have been largely responsible for this.

Supported by President WILSON, Senator UNDERWOOD succeeded in locating the nitrate plants in Alabama, not because it was the best place to get them finished quickly for the nation's defense in time of war but rather for the reason that the South would be benefited. So one need not be surprised to find in Mr. FORD'S recent offer to lease the water power and purchase the nitrate plants the same attempt to handle the two things in lump bargaining. They should be considered separately, because the factors affecting each are entirely different.

As a matter of fact not one kilowatt of power from the Tennessee River was ever used, nor need it ever be required to operate these establishments at full capacity. Both U. S. Nitrate Plant No. 1 and No. 2 have fully equipped steam power houses on the properties and are connected in a common system with the Alabama Power Co. network and the Government power plant at Gorgas, on the Warrior River.

Water-power development at Muscle Shoals, promoted in Congress on the plea of war-time emergency by the local interests and put through by President WILSON for political reasons, has always been a questionable business venture in the minds of engineers and economists. However, the first dam stands partly constructed with about $17,000,000 expended in a territory where power cannot now be sold. It is estimated that approximately $31,000,000 more must be spent to complete the entire project. Mr. FORD would have the Government expend this latter sum and he would in turn attempt to establish industrial enterprises to use the power. He would have it further grant him special rights, contrary to existing policies built up after fifteen years struggle for conservation of water power.

The Roosevelt policy, now a law, provides that water-power leases shall be limited to fifty years with possibility of recapture by the Government at the end of that time; provides for regulation of price to power consumer, and that public water power taken for profit shall make a return to the public. Mr. FORD wants a lease for 100 years with indefinite renewals at the end of that time, or, in other words, continued private possession. His offer provides for no check on what the power consumer must pay. Further, he would receive several hundred thousand horsepower for nothing.

Consistent action on the Government's part would be to make a deal with Mr. FORD or other interested parties, whereby the existing works on the Wilson dam be purchased and a standard contract be entered upon for continued development and use of power on the same basis as at any other water-power site. The partly completed dam can much more economically be liquidated at a discount on $17,000,000 than for the Government to spend $31,000,000 more in times when money is sorely needed in other departments. Liquidation of the minor sum rather than added appropriations of the larger sum for construction is certainly a business-like procedure at this time.

Mr. FORD then asks that the two nitrate plants, Waco quarry, Gorgas power plant and an 80-mile transmission line be thrown in as a sort of horse trade for only $5,000,000. Now, these are first-class properties which cost close to $100,000,000 and are not to be compared with temporary war plants like Nitro, W. Va. Writing off the excessive cost due to war times, it would cost about $50,000,000 to replace them today.

It would be necessary for the purchaser to convert Plant No. 1, costing $13,000,000, to other uses, for the process was unsuccessful at this location. However, the cost of the apparatus which would necessarily be scrapped is a small proportion of the value of the plant.

Plant No. 2 is a valuable chemical property, probably the largest in the world. It can be operated to produce several basic chemicals and fertilizers and at the same time be held intact for military emergency. There is nothing particularly mysterious or out of the ordinary about the apparatus. One 60,000-kw. power house, one process steam plant, twelve 8,500-kva. carbide furnaces, seven rotary limekilns, coal-pulverizing plant, two 600-ton mills, thirty-six nitric acid towers, 1,532 electric ovens, twenty-three 600-lb. air compressors, fifty-six autoclaves, filtering and causticizing plant, 696 catalyzers are some of the items, all usable equipment to chemical engineers. Numerous large permanent plant buildings and several hundred permanent homes are located on a tract of about 1,700 acres of land.

It is not necessary to accept Mr. FORD'S offer because it is the only one made at this time. Other companies in the chemical manufacturing business would doubtless pay considerably more for the property listed above were it not for the present financial depression. They simply cannot in sound business policy entertain expansion when their own plants are running at low capacity. In the meantime the Government can afford to wait, for cash maintenance in standby condition costs only the time of a few officers, a score of men and a negligible amount of material.

Mr. FORD shows he is a good business man, because he has conserved his cash resources to purchase when things are cheap. Maybe he could manufacture fertilizer at No. 2 so cheaply that a flivver would be found in each 2,000-lb. package. We also recall that he was going to "call the boys out of the trenches by Christmas," or, in other words, a pacifist is proposing to take over a property that may be needed in war. This situation might involve delay at a moment embarrassing to the nation. His business ability is a thing of passive interest to the private citizens, but all are actively concerned that those in command of these affairs should likewise display sufficient acumen to realize that this is not the time to throw valuable property on the market to the highest bidder. The Government can afford to wait for a better market.

Railroad Service And Railroad Buying

SOME ideas die hard, and one of these is the idea that the railroads of the United States can contribute largely to the prosperity of the country by making purchases. With many of those who are talking of prospective railroad buying, self-interest is prominent. What they want is orders. The history of American railroading can be divided into three periods. The first was a period in which railroading was exploited by speculators. The second was one in which railroads were thought to exist chiefly for the purpose of placing orders. The third period was one in which a large number of persons thought the chief function of the railroads was that of having payrolls. In the hope of making that period permanent the "Plumb plan" was devised. The railroad payrolls are now undergoing a slow process of deflation, by reducing the number of names and the quantity of emolument per name. Let us hope that a fourth period will be inaugurated in which the universal view will be that of the railroads existing chiefly for the purpose of rendering service to the public.

The idea still prevails in some quarters that normal or at least accumulated requirements of the railroads can furnish employment to a large proportion of the steel-producing industry. That is not the case now. It was the case occasionally years ago, when there were great bursts in railroad building and the iron and steel industry was very much smaller than it is now. To illustrate, more miles of railroad have been abandoned in the past few years than have been built, while in 1887 nearly 13,000 miles of road was built, the country's pig-iron-producing capacity in that year having been about one-seventh the present capacity.

Making rough but sufficiently close estimates, there is more than 300,000,000 gross tons of steel in service in the United States, while the amount in service on the railroads is less than 100,000,000 gross tons. The productive capacity, in finished rolled steel, not ingots, is about 40,000,000 gross tons a year. As the railroads are already built and need to increase in efficiency rather than in size, while uses of steel outside of railroad employment present great possibilities, it is easy to see that the future of steel demand lies outside the railroads rather than inside. If two years of full steel production could be rolled and fabricated into the particular forms required by railroads, the railroad facilities would be doubled. That would be utterly absurd.

In the first six months of this year the railroads earned at the rate of 1.8 per cent a year on their tentative valuation, when the rates prescribed by the revision of last August contemplated their earning 5½ per cent as a return on their value and ½ per cent additional, looking to betterments, or a total of 6 per cent. In six months the railroads did not do one-third as well as was desired. Some claim that rates are too high, others claim that the railroads ought to spend a great deal of money.

The better view of the railroads is that they can help the industries of the United States by furnishing convenient and cheap service, by efficient operation of an investment kept down to the lowest possible notch, rather than by spending ney. The less spending the railroads can get along with the better it will be for business in general, and the less we expect "business" to be made "good" by railroad expenditures in the next six months the less likely we are to be disappointed.

Meeting of the American Chemical Society

Report of the Sixty-Second Meeting of the American Chemical Society Held in New York, Sept. 6 to 10, 1921—Synopsis of the Papers Presented at the International, General and Divisional Meetings

THE sixty-second meeting of the American Chemical Society was held in New York, Sept. 6 to 10, 1921, with headquarters at the Waldorf-Astoria. In addition to the largest number of members ever present at a fall meeting of the society, leading chemists of Great Britain, Canada and other countries took part in the international meeting at the College of the City of New York and the other meetings held in the gymnasium and lecture rooms of Columbia University.

Council Meeting

The Council of the American Chemical Society met at 3 p.m., Sept. 6, in Rumford Hall of the Chemists' Club, with President Edgar Fahs Smith in the chair.

After the reading of the minutes the report of the committee on patents was taken up, which elicited rather lengthy discussion. In regard to the measure now before the U. S. Senate the committee reported against it on the ground that it might open the way to still greater abuses in blocking the development of American industries as practiced by German organizations previous to 1917. The conclusion was that while the Council was disposed to accept the report, it was of the opinion that more constructive measures should be included in any expression of the official opinion of the society.

The Sugar Section made an appeal that its status be changed to the Division of Sugar Chemistry and Technology of the American Chemical Society and its proposed constitution and bylaws were presented and found to be in order. By resolution the appeal was granted. The same action was taken in regard to the Leather Section, which now becomes the Division of Leather Chemistry.

Sir William J. Pope and Dr. Paul Kestner were nominated and elected by the Council to be honorary members of the society. The action was confirmed at the general meeting of the society on the following morning.

The invitation of the Pittsburgh Section to hold the September meeting in 1922 at that city was accepted with thanks. The April meeting in 1922 had already been determined to be held at Birmingham, Ala.

The editors of the several journals of the society and of the scientific and technological monographs were re-elected.

President Smith reminded the Council that the society was founded at the home of Priestley at Northumberland, Pa., and suggested that the Council bear in mind that 1926 will mark the fiftieth anniversary of the society and that a pilgrimage to the spot would be timely in connection with a spring or fall meeting which might be held in the neighborhood.

The secretary reported that on Aug. 1, 1921, the society had 15,157 members. This is about the same number as last year.

The advisory committee recommended that the officers of all divisions and sections be instructed to file with the society's news service all matters on which they desire publicity at general meetings.

Dr. John E. Teeple, on behalf of the Chemists' Club, suggested that inasmuch as the employment bureau which the club had conducted for many years had outgrown the club's facilities for housing and maintaining it, and in view of the wider scope which the bureau might enjoy if taken over by the society, the question of taking it over be considered by a special committee to be appointed for the purpose. It was resolved that such a committee, to consist of three members, be appointed, to report at the spring meeting.

The General Meeting

Three thousand chemists were present in the large gymnasium of Columbia University when the general meeting of the society was called to order by President Smith. Dr. John E. Teeple, the chairman of the New York Section and president of the Chemists' Club, was presented and in a brief greeting welcomed the sixty-second meeting of the American Chemical Society in the name of the members of the New York Section. The representatives of the sister society of the British Empire, the Society of Chemical Industry, who had come to join with American chemists in the discussion of scientific problems of mutual interest, also received a hearty greeting from their New York hosts. Dr. Smith responded for the society and expressed the gratitude of all present for the hospitality offered.

Francis P. Garvan, formerly Alien Property Custodian and now president of the Chemical Foundation, was introduced by Dr. Smith as "a gentleman to whom every chemist is deeply indebted for the services which he has rendered to the chemical profession." Mr. Garvan responded with an eloquent address on "Chemistry and the State," in which he made a dramatic appeal for chemists to accept the responsibility of teaching the people of this country the truth of Pasteur's statement that "Science is the soul of the prosperity of nations and the living source of all progress."

What the German chemist accomplished was not alone in his laboratory but in the forum of public opinion.

As an instance of the foresight of German chemical interests, Mr. Garvan told how a former American Commissioner of Patents, with the permission of an acting Secretary of State, had been induced to go to Berlin and to negotiate the patent treaty of 1909 by which Germany was released from working her chemical patents in this country. This Mr. Garvan characterized as the "crushing of the last hope of development of the organic chemical industry of this country."

Declaring that "German agents in America are once more plotting against us, he said: "If we allow Germany to stifle an American industry that would within a very few years make the United States absolutely safe, then, I say, it will have been through your neglect and temerity and failure to realize that it is your responsibility not only to search the truth but to preach it."

Telegram From President Harding and Resolutions to Congress

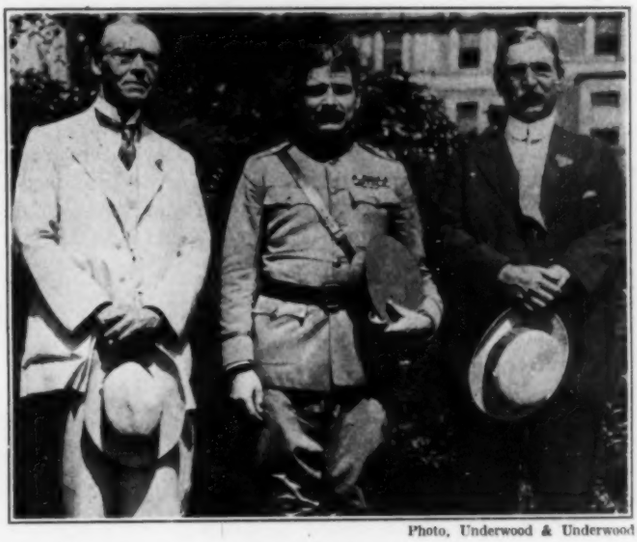
Several items of interest came before the general meeting in its brief business sessions. A telegram from President Harding was read by Dr. Parsons. The President said:

> Probably none of the materialistic sciences holds promise of so great contributions to human welfare in the coming generation as that which your organization represents. The developments of applied chemistry involve both a possibility of vastly increased horrors in human conflict and ultimately inestimable benefits to a peaceful civilization. Let us hope that a science so fraught with either good or vicious possibilities may be turned, through the wisdom of the nations, to the benefit and advancement of mankind.

Following the appointment of a committee, consisting of Drs. Chandler, Reese and Parsons, to frame a proper reply to the message from the President of the United States, resolutions to Congress were passed which requested that the coming disarmament conference should give due consideration to the subject of limiting chemical armament. The necessity of including in the permanent tariff law a temporary selective embargo against importations of synthetic organic chemicals was also urged.

Mustard Gas

Sir William J. Pope called attention to the peculiar philosophy of war. War is essentially the super-sport and anything which increases the sporting element is welcomed. Thus chemical warfare was condemned as inhumane, while preventive medicine was hailed as a blessing, in spite of the fact that preventive medicine made it possible to increase the army unit from 100,000 to 1,000,000 men and thus keep 20,000,000 men in the field. From this point of view, nine-tenths of the 15,000,000 combatants killed during the war died as a direct result of the use of preventive medicine. Contrasted with this, chemical warfare constitutes a most humane weapon of war, and mustard gas is probably the most effective casualty agent known at present.



Photo, Underwood & Underwood

SIR WILLIAM J. POPE; GENERAL AMOS A. FRIES, U. S. A.; DR. CHARLES L. REESE, CHEMICAL DIRECTOR OF THE DU PONT INDUSTRIES

Organization of Industrial Research in Canada

Prof. R. F. Ruttan described the workings of the plan for the development of industrial research in Canada. In 1916 the government of Canada by order in council established an Honorary Advisory Council for Scientific and Industrial Research, corresponding very closely in organization to the National Research Council for the United States and modeled largely on the Advisory Council for Scientific and Industrial Research in Great Britain, which has now become the Department of Scientific Research of the British Government.

Recognizing after investigation that liaison between research and industry could not be effected except by organized effort, a Central Research Institute was established near Ottawa. It is to be housed in a four-story building, 200 x 60 ft., with power plant and laboratories, the first $100,000 being specially granted by the Cabinet to get the work under way during 1921.

The functions of the institute may be briefly described as follows:

(1) It will be the Bureau of Standards for Canada.

(2) It will carry on fundamental research in chemistry, physics, biology and related fields, investigations similar to those engaging the attention of university professors in scientific laboratories.

(3) Investigations in biochemistry and bacteriology, both general and as applied to such industries as the fisheries and packing industries.

(4) Investigations undertaken on recommendation of the Research Council from time to time to promote the utilization of the natural resources and valuable waste materials of the country.

The type of research work described under these four heads will be carried on by the permanent staff of the institute, associated with specialists engaged from time to time. This group of highly qualified investigators will form an advisory body for the industrial specialists who will be engaged by the Research Council or paid by the industries "to conduct inves-

tigation and standardization at the request of any group of industries in Canada concerning the materials used by them or of the products of such industries."

The difficult question of remuneration for valuable and patentable discoveries has been left largely to the discretion of the Research Council. The intention of the Council is to give a liberal share in the commercial rights of all such discoveries. Its function is to develop research, not to exploit it.

Smoker

The big ballroom of the Waldorf-Astoria was not large enough to care for the crowd that attended the smoker which began promptly at 8 o'clock on Wednesday evening.

After a number of songs and some instrumental music the stage was set for a sketch written by Ellwood Hendrick with the aid of Miss Marguerite Merington, author of "Captain Letterblir," "Snow White" and other plays, who acted as producer. In the performance *Uncle Sam* and his secretary *Civil Service* received *John Bull* and *Miss Canada*, who arrived by airplane to attend the chemical meeting. They discussed their varied difficulties in chemical industry and *Uncle Sam* declared that his worst trouble was the fly-by-night speculator who bought control of chemical works, dismantled research laboratories, made the research reserves appear as available for dividends, then got out from under. *John Bull* said he lost some of his leading industries through just such persons. *Uncle Sam* thought it might be well if the chemist should assert himself more than he does—at which point an *American chemist* broke his way past a garrulous *Italian waiter* and wanted to see *Uncle Sam*. He was taken for a lunatic and made to sit down when an *English chemist* came in from the audience and wanted to see *John Bull*. As soon as the authorities recognized that they were chemists they gave them a hearing. They wanted to go to the meeting and their employers would not let them. This amazed the authorities, but it was a fact; their employers were afraid they might give something away. The powers concluded to get to the bottom of the question and concluded that the responsible party to reach was old *Quickturn Capital*, a man of vast wealth and arrogance who was hard to find and hard to deal with when found. At this point old *Q. Capital* burst into the apartment. He had seen a couple of chemists come in there and he wanted to fire them. He was resolved to cut out all the deadwood. Even when he learned who his hosts were he persevered in his autocratic ways, declaring that he had got what he wanted out of his chemists and now he was through with them; they were neither raw material nor finished product nor sales force nor administration. "If you ask them what they are doing," he exclaimed, "they give you a lot of hot air. They stall . . . and they eat up dividends." He soon showed himself to be unconscious of any obligations or responsibilities other than to make a good showing and then sell out. He was therefore turned over to the chemists, who squirted information into him. A telegram arrived telling him the works were shut down and they did not know what to do because the research laboratory had been closed. Then followed a transformation scene in which he begged the chemists to see him through, and all concluded to go to the meeting together.

Aside from the parts taken by *John Bull* (J. D. H. Randall), the English chemist (W. L. Cofren of the U. S. Industrial Alcohol Co.), and one of the alchemists, J. Lainson Wills, the characters were all represented by members of the staffs of CHEMICAL & METALLURGICAL ENGINEERING and other McGraw-Hill publications. *Uncle Sam* was Mr. Gordon, now business manager of *Ingenieria Internacional* and formerly of CHEM. & MET.; *Canada* was Mr. Shaver of *Engineering News-Record; Civil Service* was Mr. McNamara of *Engineering News-Record;* the *Italian waiter* was our own business manager, Mr. Fellner; the *American chemist* was Mr. Spooner, also of CHEM. & MET., and *Quickturn Capital* was Dr. Hendrick. The two alchemists who carried the banner were respectively Mr. Wills and Mr. Kirkpatrick, our assistant editor.

The play was followed by two professional acts, and the singing of several parodies of songs relating to various prominent members and visitors concluded an enjoyable evening.

International Meeting

The international meeting was held Thursday, Sept. 8, in the Great Hall of the College of the City of New York. Dr. Edgar Fahs Smith presided. "Chemistry and Civilization" was the subject expounded from different viewpoints by Drs. Charles Baskerville, A. D. Little, L. H. Baekeland, Sir William J. Pope, W. R. Whitney, C. E. K. Mees, Ernst Cohen and W. D. Bancroft.

SCIENCE AND CIVILIZATION

Dr. Charles Baskerville spoke on "Science and Civilization," with particular reference to the value of chemistry as a civilizing influence. He called attention to the remarkable progress of the world during the past 150 years, stating that more had been done during that time than in all previous centuries combined. After outlining the development of learning from early times and proving the part which research and science had in this development, Dr. Baskerville concluded by stating that chemistry must play a great rôle in preparing the "cement" which will bind mankind in brotherhood.

ENERGY: ITS SOURCE AND FUTURE POSSIBILITIES

In his paper on "Energy: Its Source and Future Possibilities," Dr. Arthur D. Little outlined the vast work to be done to brace up our broken civilization and the immense requirement of energy to accomplish the undertaking.

The energy available from sources at hand is inconceivably greater than human needs—if we but knew the art of capturing it. There is, for instance, the radiant energy of the sun, of which Sir Oliver Lodge says the earth receives but one one-hundred-and-fifty-millionth part. It is only three small calories per minute per square centimeter of the earth's surface; but Ciamician has calculated that a surface of only 10,000 square kilometers, assuming six hours as the effective day, receives in a year the quantity of heat that corresponds to the burning of 3,650 million tons of coal, or more than double the world's production. The desert of Sahara with its 6,000,000 square kilometers receives daily the solar energy equivalent to 6 billion tons of coal. The world awaits the genius who will convert the radiant energy of the sun into electric current. Of the minute portion of solar energy received by the earth, only one three-hundredth part is stored up in plants. They, nevertheless, according to Ciamician, produce 32,000,000,000 tons of vegetable matter which,

if burned, would develop a quantity of heat equal to that derived from 18,000,000,000 tons of coal.

The energy of the earth's rotation has thus far been used only in the application of the gyroscope. That of the wind and waves is too uncertain and diffused to encourage extensive exploitation. There are two extensive tidal power developments under construction, at St. Malo in France, and at the mouth of the Severn River in England. The latter will provide 437,000 continuous horsepower. The continuous tide power of the British Isles has been computed to be 2,250,000. The capital requirements for such installations is naturally more than double that required for continuous falling water.

In Italy a 30,000-hp. steam turbine installation has been made for which the energy is derived from steam issuing from the vents in the side of a volcano.

Sir Ernest Rutherford has said that "the human race may date its development from the discovery of a method of utilizing atomic energy."

Our civilization is based on coal. In 1913 the world's resources were summarized as follows: Including 3,000,000 units of lignite, the total reserves are 7,400,000 units, of which 5,000,000 are in North America, 1,280,000 in Asia, 784,000 in Europe, 50,000 in Africa, and 25,000 in South America.

One-tenth of the population of the United States is dependent on natural gas. In 1917 we used 800 billion cubic feet and wasted 800 billion more. In 1920 our production was below 650 billion. Our misuse of this is an indictment of individualism.

Of petroleum the United States now produces 70 per cent of the world's supply. Our reserves are nearing depletion and we can scarcely maintain the present rate for twenty years more. We need an intelligent economic petroleum policy in the United States and the power to enforce it.

Shale oil is a resource for the future, and so is our peat supply, and so too are the striking possibilities in the production of power alcohol.

The water power of the United States is sufficient to drive every factory and light every building in the country, but development is inhibited by the cost to construct, inasmuch as bond interest represents 77 per cent of operating costs.

Coal must remain for generations our chief energy resource.

The Engineer: Human and Superior Direction of Power

"The forces of nature are the most enduring wealth of mankind. To know their laws and to learn how to apply them has made of a puny little being of about 130 or 200 lb. of flesh and bone—three-fourths of which is merely water—a giant of which Gulliver's tales have no equal." This was the opening remark of Dr. Leo H. Baekeland, in his address on "The Engineer: Human and Superior Direction of Power."

He stated further that there are few who fully realize that a co-ordination of the thoughts and work of the chemists and chemical engineers is indispensable for the successful practical progress of the chemical industry. The chemist is a scientist. By direct observation or experiment, and aided by theoretical reasoning, he tries to correlate observed facts until he believes that he is warranted to generalize thereon. He thus helps to discover new truths or laws of nature which in their turn will permit him to predict facts in advance. But the experience of many a scientist has been confined exclusively to laboratory work, or to purely chemical subjects, and this is frequently the reason for his weakness in dealing with practical matters. The ways of thinking and acting of a chemist and those of an engineer are often along decidedly different points of view. Yet, if these points of view can be compromised or harmonized, they bring forth good chemical engineering.

Chemistry and Life

Sir William J. Pope, in speaking of chemistry in relation to life, said that during the last fifty years the organic chemist has forged for himself new tools in which low potential energy is applied and induced to take part by the presence of the so-called catalyst. Obviously organic chemistry is approximating in its experimental methods those which occur exclusively in plant and animal life.

When we possess full working details concerning the plant leaf process for converting carbon dioxide and water into formaldehyde and oxygen by utilizing the sun's energy, when we can make indigo and quinine by the identical processes carried on in the plant, chemical technology will be an entirely different proposition from the one it now represents.

We must also recognize that wide economic differences exist between a self-contained European country and others which have the whole tropical world within their range, and that entirely distinct types of problems are in consequence presented to their chemical technologists. It is for us to realize all the bearing of these differences upon chemical science and chemical industry and to see that we neglect no means for applying the great opportunities within our reach in the service of mankind and of our respective countries.

Theories

A system of theoretical mythology was advanced by Dr. Willis R. Whitney, in an address on "Theories." Whitney avers that Prometheus was the first theorist, and his daring conceptions and swift conjectures gave early man many of his comforts and necessities. But unfortunately, his theories were too daring, often disregarding fact, and he was finally chained to a mountain top so he could keep at least one foot on the ground. His slow-witted brother Epimetheus was also a theorist, but better, he was in addition the first experimenter. His first investigation consisted in opening Pandora's box, and disclosed not woes to afflict the race, as claimed by some, nor blessings ever lost, as maintained by others, but in fact nothing but enigmas, which the finder and his descendents have since been striving to solve. All theorists and experimenters have since been disciples of Prometheus and Epimetheus, and all theories God-given or earth-born are of value, even if the latter sort are finally disproved, for they lead to further experiments.

Research Applied to the World's Work

If we all had enough there would be no need for unrest and hence no great inducement for research and advancement. This is the first major thought in C. E. K. Mees' address, "Research Applied to the World's Work." However, with education comes a demand for the opportunity to insure one's own future. Fail to satisfy this demand and a chaos of unrest will follow.

The modern world, the world as it is, is the creation

of a very few years of technical discovery and development. Modern wealth, especially of the United States, has been produced as the result of technical and scientific progress in research.

The function of a research laboratory is "to supply the technical information on which an industry is operated." This applies as well to sales or utilization of products as to production. It thus serves as the intelligence department in industry, supplying the information on which decisions are made, not only those of advance or new development, but also those to withdraw from or avoid technically unpromising lines.

Problem of Diffusion and Its Bearing on Civilization

Dr. Ernst Cohen, famous Dutch chemist, and professor of chemistry at the University of Utrecht, addressed the meeting on the subject of "Diffusion and Its Bearing on Civilization." The history of the process of diffusion was traced from its discovery in a French abbey in 1770 to its final explanation by van't Hoff in 1885. The development of physical chemistry may be said to have dated from the work of this great Dutch chemist. Prof. Cohen declared that realization of the important rôle of diffusion in the processes of living matter is the foundation on which we may hope some day to build up a complete understanding of life's processes. In concluding his address, the speaker referred to the work which is being done at the University of Utrecht in connection with the accurate determination of the coefficients of diffusion. He intimated that the final publication of the results of this research will reveal that many of these important physical constants, as previously determined, are in error because they were obtained in buildings and apparatus subject to vibration.

Catalysis: The New Economic Factor

War's destruction of capital must be restored if nations are to continue to progress, and Prof. Wilder D. Bancroft declared in his address that chemistry, better applied through the use of catalysis, is the most promising means of accomplishing this end. Catalytic agents may prove to be the important economic factors which will some day produce liquid fuel from coal or light without waste of heat and energy, scientifically control the rain from the clouds, and finally render solar and atomic energy completely useful to man.

Organic chemistry in the past has failed to use catalysis to any great extent, but the work of Sabatier, J. J. Thompson and the recent data of Reed of Johns Hopkins indicate that the trend is in this direction.

Presidential Address—Progress in Chemistry

Those who were fortunate enough to hear the presidential address of Dr. Edgar Fahs Smith cannot but marvel at his remarkable insight into the history of chemistry in America. Choosing as his text the words of Berthollet, "Chemistry has become regularly and philosophically progressive," President Smith traced step by step the inspiration and impetus given to those who have contributed to the advance of American chemistry. Over a century and a quarter ago the pioneer chemical society of the world—the Chemical Society of Philadelphia—was assembling and disseminating information relative to the manufacture of niter, even as American chemists of 1914 to 1918 harkened to the call of their country in its hour of peril.

However, not all of the thoughts of our chemical fathers were of the implements of warfare, for, as Dr. Smith affirmed, many domestic industries had their conception in the minds of these pioneers. The making of sal-ammoniac, glauber's salt, oil of vitriol, prussian blue and numerous other pigments, and in fact even a few American dyes was well under way over a century ago.

Furthermore, these early investigators "felt it their duty to publish and disseminate the knowledge they were acquiring through their investigations. They did not seek to hide their discoveries. They believed in publicity. They desired that their science might receive honor, but also that their country might be assisted in winning its way among the nations looking down upon it.

"My desire is that we have no East, West, North or South in chemistry, but one united body from all sections eager to carry the science into every walk of life—even into the halls of government, that their occupants may understand how intimately chemistry is interwoven with the laws and welfare of the land."

Division of Dye Chemistry

The Dye Division convened Thursday morning with A. B. Davis in the chair and R. Norris Shreve as secretary.

The meeting was well attended and the papers contained information of value.

A few of those having general interest are noted here.

W. F. Prescott, of the Sherwin-Williams Co., spoke on the dye situation in Canada. He said there were 80 woolen mills, 20 cotton mills, 80 knitting mills, 8 silk mills, 130 leather plants and 50 paper plants in the dominion, producing about $220,000,000 worth of goods annually, against about $55,000,000 worth in 1911. In regard to dyes, they do not expect to produce intermediates or many varieties of dyes. Their imports for the year ended March 1, 1921, were $630,000 worth from England, $2,500,000 from the U. S. and $200,000 from Germany and Switzerland. He was of opinion that considerable German dyes came in as Swiss.

J. P. Schmidt, of the Monsanto Chemical Co., presented a paper on lakes prepared from para-phenetidine. There are fifteen to twenty colors of this type made from phenacetine as the basic intermediate. Para-phenetidine coupled with beta-naphthol gives a beautiful bluish red which, precipitated on chalk, was exposed to varying weathers for three months during the spring and held remarkably well, showing great fastness to light. It is somewhat soluble in oil, which makes it available for shoe polish, wood stains, etc., or wherever solubility in oil is desired. By diazotation the solubility in oil is overcome and a series of colors from orange to bluish reds is obtained.

E. R. Harding, also of the Monsanto company, spoke on the synthesis of anthraquinone from phthalic anhydride and benzene. The only available crude for anthraquinone heretofore has been anthracene, but the claim has been made that the removal of this crude, needed for many of the most desirable vat dyes, from pitch renders the pitch unavailable for roofing and road making.

Dr. J. L. Bulloch, of the Uniform Chemical Products Co., read a paper on "Improving the Yields and Quality of Our Dyes and Reducing their Cost." He emphasized the need of thorough knowledge of intermediates and the requirement for greater precision in quality tests.

Dr. L. A. Olney, of the Lowell Textile School, told of the "Extraction Process for Degreasing Wool" instead of the usual method of scouring by emulsion with soaps. A plant of sufficient size costs several hundred thousand dollars. The Arlington Mills, which has the only installation in the country, applied an invention of Emile Martens of Providence, which has proved excellent, using petroleum naphtha. It has been in use for twenty-five years without an accident, all the potash is recovered and over 1,000,000 lb. of raw wool per week is treated. The wool so extracted is much purer than that scoured in the ordinary way with soap and it takes up dye so fast that it may not be successfully dyed when mixed with that scoured in the usual manner.

Dr. Leon W. Parsons and W. A. McKim, of the Massachusetts Institute of Technology, contributed a paper on "The Effect of Dye Structure on Dye Adsorption." This was in accord with Langmuir's theory in regard to the relation of the structure of molecules to color and shade and the effect of fields of force due to internal structure extending beyond the confines of the molecules, on their behavior.

Dr. J. Merritt Matthews, editor of the *Color Trade Journal*, asked, "Is an Export Trade Necessary to Our Dye Industry?" The United States consumes about 12 per cent of the world's production of dyes. No embargo can last over a few years. Is there enough in the American market to keep the industry flourishing? Some dyes can be made profitably under fair conditions, but others are not used enough to make it worth while to produce. He held it desirable to recapture foreign trade which is now fading away and noted the Department of Commerce is ready to co-operate.

Oscar R. Flynn, of the Walderich Bleachery, discussed the fastness of dyed textiles to stoving, which would appear to be the opposite of fastness to light, but which he regards as having to do with conditions of air which envelops the fabric, some of which is prevented by containers from the usual measure of diffusion.

Gaston du Bois spoke on the features of cost and pointed out the effect of high costs on exports. The United States exported dyes as follows:

1917	$7,548,000	January,	1921,	$1,292,709
1918	15,266,000	February,	1921,	467,764
1919	15,728,000	March,	1921,	670,261
1920	29,823,000	April,	1921,	365,010

More than half of the above went to Asia and South America, but owing to high costs Germany is rapidly recapturing those markets. Our costs are from two to three times those of Germany today. Wages and salaries are seven times as high, but these are unimportant compared with volume, yield and experience. He favored a good downward revision of investment accounts.

C. R. DeLong of the Tariff Commission spoke of "The Present Status of the Domestic Coal-Tar Products Industry." From 1917 to 1920 inclusive the output of the United States was approximately doubled. Indigo increased from 275,000 lb. in 1917 to 18,000,000 lb. in 1920—nearly double the pre-war importation. Average price in 1917 was $1.24, against 74c. in 1920. Now it is 40c. Vat dyes other than indigo increased from 15,000 lb. in 1917 to 1,160,000 in 1920. Coal-tar medicinals doubled, to 5,000,000 lb., in 1920, and perfume materials increased from 19,000 lb. to nearly 100,000 lb. in 1920. Synthetic resins reached 4,500,000 lb. and synthetic tanning materials 3,000,000 lb. Triphenyl and tricresyl phosphates were introduced as camphor substitutes in pyroxylin plastics.

In the coal-tar products industry between 10 and 11 per cent of the men employed are chemists. The cost of research from 1917 to 1920 inclusive has been materially over $15,000,000.

Greatly needed in the dye industry is a standardization of dyes and a revision of the present conflicting and bewildering nomenclature of these products.

Division of Industrial and Engineering Chemistry

The meetings of the Division of Industrial and Engineering Chemistry were held Wednesday, Thursday and Friday. There was a symposium on filtration, one on gases and fuels, and general papers.

Symposium on Filtration

D. R. Sperry acted as chairman of the Symposium. Sixteen papers were presented.

In his paper on the fundamental laws of filtration with suggestions regarding research work, Mr. Sperry called attention to the fact that filtering has not been developed on a scientific basis and that the fundamental laws must therefore be studied.

The three essentials involved are the filter base, a difference of pressure, and a filter or mechanical device for containing the operation. Studies have shown that the flow of liquid through a porous mass varies directly as the pressure and inversely as the thickness of the cake. One series of tests led to the conclusion that the flow varies as the first power of the pressure, denoting capillary phenomenon.

Eustice A. Alliot, a visiting member from Great Britain, gave another of the papers on fundamental data which he has worked out in the study of washing and washing ports used with chamber and frame types of filter presses. The following paragraphs cover a short abstract of his work.

Nominally, washing consists of the displacement of mother liquor from pores between particles by an equal volume of wash, in which case little mixing of wash and mother liquor takes place. Such perfection is theoretical, and various disturbing factors enter, the chief ones of which are:

1. Adsorption,
2. Capillary diffusion,
3. Formation of chemical compounds,
4. Colloid formation on the removal of electrolytes.

Adsorption is the unequal distribution of the solubles at the boundary between solid and liquid phases of the cake owing to surface energy effects. A large excess of solubles is retained in the surface film and will not wash away. The effect is proportional to the area of boundary surface and is most important in finely divided or gelatinous precipitates. The washings may be graded and used in succession, finishing with a small proportion of pure wash.

Absorption of mother liquor by capillary diffusion into the pores of the cake particles requires a dilute wash to be effective and a time factor comes into play. In the case of iodine and charcoal, weeks may be required before an equilibrium is established. The effects are similar to but more complex than adsorption, involving more wash and longer time.

Chemical combination with the substance of the filter particles where such compounds are stable only when the concentration of the liquid phase is in excess of the critical amount often occurs in fine chemical

manufacture. In such conditions the excess of wash required varies directly as the quantity of solubles retained and inversely as the critical concentration.

Some precipitates are held in the coagulated state only in the presence of suitable electrolytes. When these are removed by wash water a finer structure of cake results or it may even disappear entirely. Stage treatment with washes of graded strength may be used so that the entering wash always contains a little electrolyte.

In obtaining best results for thorough washing, it appears necessary to have a plate and frame press, a means for air elimination, and the wash must leave at the top of the press so that the cakes remain immersed in the bath of wash eliminating unbalanced hydrostatic head.

It cannot be too clearly understood that good results depend not merely on the mechanical arrangement of the press but almost more on the attention paid to getting proper physical condition of the material and delivering it in a suitable manner to the press. Every detail of the operation should be correct.

Other Papers in Filtration Symposium

Alvin Allen Campbell, of the Newark Wire Cloth Co., compared the animal and vegetable materials for the production of filter cloth with the metals. Cotton duck has been used, but together with wool, hemp, jute, etc., is too slow. Strength is an important essential of a filter base, but the greatest difficulty encountered is with leakage.

H. D. Atkins described an automatic filter press which is pivoted near the center of its length. When the cake has been formed the press is turned on the pivots to a vertical position, so the cake may be removed without opening the leaves.

H. A. Vallez, of Bay City, Mich., described a new rotary filter which consists of a cast-iron cylindrical shell arranged in the horizontal position and completely housing the filter elements which revolve on a hollow shaft. Sprays remove the cake from these elements and it falls to a screw conveyor on the lower side. The driving gears are placed at one end of the casing and the filtrate discharge at the other.

H. C. Beckman, of the De Laval Co., outlined the four uses of centrifugals as pertaining to extraction, separation, clarification and filtration. Filtration by centrifugal was first tried in perforated drums, but it was found that the cake became quickly compressed until it was impervious. The non-perforated rotor consisting of a series of drums or shelves mounted on a vertical axis and revolving at a speed of 6,000 r.p.m. was then developed.

Arthur Wright classified industrial filter media, in the main consisting of fabrics used with corrosive and non-corrosive materials. Cotton is largely employed for non-corrosive liquids. There is need for standard methods in specifying filter cloth. It should be known by the size of yarn, the number of threads per inch in warp and weft, and by the weight per unit of area.

Cotton and wool fabrics will not stand strong caustic solutions. Wool will resist acids, though cotton is sometimes better where necessary care is employed. Tests should be made to determine the best filter medium for each problem.

E. E. Finch spoke on the development of filtermass filters in the brewing industry and the subsequent applications for clarifying vinegar and food products.

C. P. Derleth and G. M. Hickey covered the use of FilterCel as an aid to filtration and its specific application in several industries.

G. D. Dickey described the machines marketed by the Industrial Filtration Corporation, showing numerous slides of all types.

Robert C. Campbell gave an illustrated talk on the apparatus manufactured by the United Filters Corporation, which includes the Sweetland and Kelley presses and the American continuous vacuum filter.

Symposium on the Chemistry of Gases and Fuel

The four principal topics for discussion at the symposium on the chemistry of gases and fuel were: (*a*) Coke-oven problems, (*b*) low-temperature carbonization, (*c*) gas works control, and (*d*) gas analysis and its applications. C. H. Stone of the Rochester Gas & Electric Co. acted as chairman, R. S. McBride, secretary.

According to F. W. Sperr, Jr., who opened the discussion on coke-oven problems, the fundamental research needed is now more appreciated than ever before. Knowledge of the constitution of coal is one of the outstanding needs in connection with the fuel supply itself. In the case of coke the past work has dealt mainly with the question, "How to make it?" Now the need is to answer, "What is it?" Specific heat and heat conductivity data, among other physical constants, are much needed, as are further facts as to the sulphur forms in both coal and coke. The byproducts other than coke of course afford an unlimited field for investigation.

Low-temperature carbonization of coal was discussed by Horace C. Porter. In his opinion the largest opportunity today for low-temperature work is as an adjunct to gas works, especially where the complete gasification of the fuel can be had through some "double-gas" system, the coke from the first stage being used in a form of water gas machinery for the second.

The discussion of needed carbonization investigations included reference to the study of the thermal history to which fuels are subjected during processing and extensive investigation needed for determination of thermochemical data. It was made clear by Dr. Fieldner that only through a full knowledge of how coke of various types can best be used will it be possible to persuade the blast-furnace operator to take any type of coke which can best be made in view of the current market requirements for byproducts.

Chemistry in gas works control was discussed by E. C. Uhlig, who pointed out the large opportunity for further chemical investigation in theoretical lines which undoubtedly would afford sound basis for industrial development of the future. C. H. Stone brought out clearly the numerous miscellaneous problems which are presented to the gas works chemist for solution.

Arthur L. Davis described two methods for determining light oil in coke-oven gas. The first covered the absorption of the light oil in charcoal, but distilling with cresol or cresylic acid instead of glycerine. The second is a method of absorbing light oil in cresylic acid which has been developed in France on a commercial scale. A plate and bell tower with ten plates and bells is used with countercurrent flow.

George C. Brown, Jr., gave an exhaustive paper on the chemically controlled automobile. He showed methods of analysis, stated that 30 per cent of the gasoline passes out the exhaust in unburned gases and

finally that too much stress had been laid on the mechanical features of the gas engine when the big losses involved chemical engineering. In another paper Mr. Brown gave short-cut methods for calculating the temperatures of combustion.

The members present voted to request the secretary of the Division of Industrial and Engineering Chemistry to undertake to determine whether the organization of a section on the chemistry of gases and fuel would be justified, and if so to formulate a request to the proper officers of the society.

General Papers

E. F. Collins, of the General Electric Co., abstracted an able paper on electric heat for thermal processes, showing numerous slides of industrial electric appliances. He stated that considerations of other features than the cost per B.t.u. play an important part. Electrical heat gives safety, more uniform temperature and economy of labor in operation.

Robert E. Wilson gave data determined and collected on the humidity equilibria of common materials. Tests were made at M. I. T. on substances with the humidity of the air at 15, 30, 50, 70 and 95 per cent. Curves plotted for each substance showed that most common ones lie between the sulphuric acid curve and the amyl alcohol curve.

Robert E. Wilson, William H. McAdams and M. Seltzer have made a study of the frictional resistance to the flow of viscous liquids through pipe elbows and compiled data from a series of 200 tests. There is no important difference between the flow in common smooth pipe and glass tube. In turbulent flow the resistance of an elbow was confirmed to require an additional correction of length of pipe corresponding to 35 pipe diameters, while with viscous flow only 4 or 5 pipe diameters need be added to length to correct for resistance of the elbow.

P. C. Haeseler described a new process developed at Columbia University and later tried on a commercial scale for the manufacture of sulphuric acid. It is noted that selenium is involved in the reaction but is not a contact or catalytic agent. The reaction used is

$$SO_2 + H_2SeO_3 + H_2O = H_2SO_4 + Se$$

Selenium is roasted in a furnace to SeO_2 and passed into a tank of water to form H_2SeO_3. This is slowly sprayed in very finely divided state into the top of a chamber where the SO_2 gas is introduced. Sulphuric acid, about 50 per cent strength, forming a slurry with selenium, is drawn off at the bottom and passed through rotary filter having Monel metal screen. The filtrate is ready for the market as 50 per cent H_2SO_4 or sent to the concentrating plant. The sludge of selenium is returned to the roaster.

C. J. Rodman determined that mineral and chlorinated oils were ruptured with an electric arc of 100,000 volts, 333 cycles, by temperature and pressure effects rather than by sympathetic vibration.

H. P. Holman abstracted his paper covering the effects of waterproofing materials upon the tensile strength of cotton yarn. Bituminous materials are the best treating compounds as regards the effect on tensile strength. Raw drying oils are not so good as those mixed with metallic compounds. Rosin reduces tensile strength and yarn treated with cold vulcanized rubber shows an immediate and marked deterioration. Oleic acid causes deterioration and lead oleate is poorer than other oleates.

E. C. Bingham held the chair for the discussion of special order on world standardization, which was an informal symposium on the adoption of the metric system in the U. S. The report of the committee for the adoption of standard metric units for the purchase of chemical apparatus and supplies showed that out of 600 universities and colleges questionnaired about 150, including large institutions, have signified their intention of purchasing by the metric system. Twenty-four dealers are willing to supply in both English and metric units. Some of these will feature the fact in their advertising. W. A. Noyes moved that the division ask the advisory committee of the A.C.S. to indorse House Bill 10. The slogan for the chemists is to be, "Pure chemicals purchased by the metric system, in standard packages."

The officers and committees of the division for the coming year were elected as follows: Chairman, Warren K. Lewis; vice-chairman, D. R. Sperry; secretary, H. E. Howe; assistant secretary, E. M. Billings; executive committee: W. F. Hillebrand, Edward Mallinckrodd, Jr., F. M. DeBeers, Alexander Silverman, Herbert R. Moody, C. E. Coates, W. D. Richardson, F. E. Breithut, C. O. Johnes.

Division of Physical and Inorganic Chemistry

A well-rounded program of nearly fifty papers occupied the attention of the physical and inorganic chemists during Wednesday, Thursday and Friday. H. N. Holmes was chairman and S. E. Sheppard secretary.

It is impossible here to summarize all of the many papers presented but a number of the most interesting are briefly referred to in the following paragraphs:

The increasing interest in this field was evidenced by the presentation of papers on the transitional temperature of gelatin and the swelling and gelation of gelatin by Dr. B. H. Bogue of Mellon Institute; the fluidity-pressure curves of gelatin solutions by Dr. S. E. Sheppard and his co-workers of the Eastman laboratories, and on the plasticity of colloids by Prof. E. C. Bingham of Lafayette College and Prof. Robert E. Wilson of Harvard University. Dr. Bogue presented evidence favoring a concentration-variable transition area between the sol and gel states. In the discussion E. T. Oakes stated that certain of his data indicated a concentration-invariable transition point. Dr. Sheppard declared that he had obtained confirmation of both points of view but found difficulty in bringing the two into complete harmony. Bingham pointed out the coordination of Bogue's data with those obtained by R. A. Gortner on flours and by himself on clays.

Messrs. Lichtenwalner, Flenner and Gordon sought to determine the maximum adsorption of solutions of calcium, magnesium and potassium acid phosphates by iron hydrogel and aluminum hydrogel. The sulphates of these metals were also used with iron gel. In both instances the calcium salts were adsorbed to the greatest extent, while those of potassium were least adsorbed.

Electrometric titration methods were used by W. Mansfield Clark and his co-workers in a study of oxidation-reduction equilibrium with a view to developing a series of indicators similar to the acid-base indicators of Lubs and Clark. The reduction of various indigo sulphonates, methylene blue and its homologues, and of the different indophenols by means of titanium citrate were studied. In general p_H was held constant for each determination by the use of a buffer agent.

Prof. Harold A. Fales and Harold E. Robertson of

Columbia University ask the question: Are electrolytes completely ionized at infinite dilution? The preliminary report on their work on this subject apparently answers this question in the negative.

Dr. Saul Dushman of the General Electric Co. and Miss Mary A. Andrews reported on the reaction between tungsten and hydrocarbon vapors. This phenomenon is of importance, because the oil pumps used for evacuating incandescent lamps give off hydrocarbon vapors which under the conditions of high temperature and vacuum have a deleterious effect on the tungsten filaments. Using naphthalene vapor, it was found that at constant temperature of filament and pressure of naphthalene the conductivity of the filament decreases uniformly with the time, until a minimum point is reached at which, as shown both by the hydrogen evolution and chemical analysis of the filament, the filament is completely converted to W_2C (corresponding to 3.18 per cent C). The conductivity of this carbide is only 8 per cent of that of pure tungsten. Further decomposition of the naphthalene leads to the formation of the higher carbide WC, the conductivity of which is about 40 per cent of that of pure tungsten.

Dr. A. P. H. Trivelli, with E. P. Wightman and S. E. Sheppard of the Eastman laboratories, reported on the results of the pioneer work they are doing in the investigation of the photochemical properties of photographic emulsions.

In order to do away with the dielectric, which is one of the principal causes of the unreliability of commercial ozonizers, Dr. F. O. Anderegg of Purdue University has studied a high-frequency discharge apparatus for the production of ozone. Its chief advantage lies in the fact that it is impossible to maintain a high-frequency arc. An aluminum tube 5 x 190 cm. with a concentric wire was used for the discharge. Current was supplied up to half an ampere and 7,000 volts at about a million and a half cycles frequency by a small Tesla coil. The highest yields were obtained with a rather large wire provided with numerous small points so that the discharge should be made up of many brushes. The ozonized air contained but small amounts of nitrous oxides, although on raising the voltage till the discharge was filled with sparks about 0.02 per cent was obtained. Numerous curves have been worked out showing the relationships between the different variables, which are usually similar to those obtained in low-frequency ozone production.

Prof. Alan W. C. Menzies described an ingenious differential thermometer which he devised for use in ebullioscopy. In its simplest form it consists of a small glass U tube filled with water. The lower arm of the tube is closed to form the bulb of the thermometer, and to other, which has a closed reservoir at its tip, consists of a carefully calibrated capillary tube. A degree rise in temperature will cause as much as 200 mm. rise in the water in the capillary.

Claude H. Hall, Jr., has repeated and confirmed the work of Patterson on the decolorizing action of bone black. By extraction of hydrochloric acid washed bone black with sulphuric acid an extremely active decolorizing agent was prepared. By precipitating this compound on wood charcoal or other porous substances, a material identical in chemical action with bone black was obtained. This active principle was found to be a mixture of nitrogenous decomposition products of bone cartilage.

C. R. McCrosky and A. J. King discussed the preparation of the selenides of ammonia. They have found that when ammonia is present in excess in the reaction between ammonia and hydrogen selenide, a colorless liquid containing selenium equivalent to normal ammonium selenide is formed. This compound freezes at 10 deg. C. On losing ammonia it changes to a white crystalline compound corresponding to the biselenide, NH_4HSe.

R. A. Gortner and W. F. Hoffman, in a paper entitled "An Interesting Colloid Gel," pointed out that gelatin, agar agar, and even silica gels were not always satisfactory as standard gels due to variation in quality. It was pointed out that a rigid gel can be prepared from dibenzoyl cystine containing as little as 0.15 per cent of the compound. Viewed by dark field illumination, this is apparently a crystal gel. It is suggested that this material may assist in studies regarding gel structure.

Dr James W. McBain, professor of physical chemistry at the University of Bristol, England, in his studies of the adsorption of toluene and acetic acid by carbon has obtained results which appear to substantiate the theory that adsorption consists in the formation of a monomolecular film entirely covering the surface of the carbon. By diminishing the temperature difference between the carbon and the toluene, equilibrium was reached between the two and a definite value obtained for $\frac{x}{m}$; the measure of adsorption.

The preparation of a ferric hydroxide gel as an absorbent for gas defense was described in a paper by Messrs. Robert E. Wilson, William B. Ross and Leon W. Parsons. Using 6 per cent solutions of ferric chloride and sodium hydroxide, a dark brown gel was obtained by complete precipitation. After washing by decantation, it was filter-pressed and vacuum-dried to a moisture content of about 10 per cent.

New Officers Elected

Following the formal presentation of the papers, a business session was called. The nominating committee reported the following officers for the new year, and they were duly elected: Chairman, Dr. S. E. Sheppard; secretary, Prof. Robt. E. Wilson; executive committee, Messrs. Blum, Hildebrand, J. H. Mathews, and Weiser.

To Continue the "Journal of Physical Chemistry"

At the meeting on Friday the chairman, Prof. H. N. Holmes, called the attention of the division to the statement by Dr. Bancroft that he would be unable to continue the publication of the *Journal of Physical Chemistry* after December of this year. It was the opinion of the meeting that this action would be of the nature of a catastrophe to investigators in the field of physical chemistry. The chairman apointed a committee consisting of Messrs. Bingham, Abbot, Menzies, Kendall and McBain and instructed them to report a definite plan of action. This committee subsequently recommended that the division urge Dr. Bancroft to continue to edit the journal for another year and that in the meantime a representative committee should be appointed to devise a permanent plan for continuing this or some similar journal. It was suggested that the committee look to the British for co-operation with the idea of creating an international medium. The report of the committee was accepted and plans were formulated for organizing the work of the large committee.

Division of Leather Chemistry

The meetings of the Division of Leather Chemistry were held during Wednesday, Thursday and Friday, Sept. 7 to 9, under the chairmanship of John Arthur Wilson.

Among the papers presented were the following:

Color Measurement of Vegetable Tan Liquors

The difficulties encountered in attempting to measure the colors of vegetable tan liquors were discussed in a paper sent in by Prof. Henry Richardson Proctor. The applications of the colorimeter, tintometer, brown-yellow glasses and iron alum solutions were all considered. It was suggested that the most satisfactory method might be to determine the depth of solution necessary to absorb one-half of the light from several different parts of the spectrum.

Color Value of Tan Liquor as Function of p_H

John Arthur Wilson and Edwin J. Kern found that the natural coloring materials in vegetable extracts act like indicators with changes in the reaction of the liquor. The color is a function of the hydrogen-ion concentration. Thus a series of gambier and quebracho extracts varied in color from a pale straw at a p_H of 3 to a dark red at a p_H of 12. This change in color is completely reversible if the liquors are not long exposed to air. In a similar manner the color of the leather varies directly with the p_H of the liquor used.

Upon exposure to air the liquors darken and this oxidation progresses more rapidly in the liquors having the higher p_H values. In this case the color change is not reversed by lowering the p_H.

Chemical Combination in Chrome Tanning

Two papers of a series establishing the chemical nature of the combination of chromium with hide substance were presented by Arthur W. Thomas and Margaret W. Kelly, "The Equilibria Between Tetrachrome Collagen and Liquors of Different Chrome Content" and "Adsorption of the Constituents of Chrome Liquor at Various Concentrations After Nine Months' Contact."

Continuing the work which proved the formation of a tetrachrome collagen compound, the authors were able to prepare an octachrome collagen, which would indicate that collagen had a combining weight of 93. It was further possible to prove that the formation of these chromium: collagen compounds is a reversible process, and that chrome tanning is essentially a chemical process.

Influence of Certain Neutral Substances on Chrome Tanning

Arthur W. Thomas and S. B. Foster studied the influence of sodium sulphate, sodium chloride and sugar upon the combination of hide substances with chrome. The fact that chrome liquors can be made more basic without precipitation in the presence of certain salts and substances has been explained by the ion hydration theory. This theory does not, however, account for the difference in the action between NaCl and Na_2SO_4. When the concentration of NaCl is plotted against mg. Cr_2O_3 per g. hide substance, the curve passes through a minimum and then rises to practically the original value. With Na_2SO_4 there is a continuous drop and no recovery.

Experiments with sucrose (which is known to hydrate in solution) showed almost no influence until the solution became quite concentrated. Hence the authors conclude that the initial action of NaCl is due to the formation of an addition compound and that the recovery is accounted for by the later predominating influence of hydration, while in the case of Na_2SO_4, which does not hydrate, there is no recovery.

Physical Mixtures and Chemical Compounds

Dr. Jerome Alexander discussed in a most interesting manner the question of differentiation between physical mixtures and chemical compounds. As in similar problems, there is no sharp line of demarkation and the whole matter rests upon the acceptance of a set of definitions by all interested in the controversy.

Effect of p_H Upon Diffusion of Tan Liquor

As ordinarily used in tanning, gambier and quebracho extracts show marked differences in the rate of tanning and of penetration into the hide. In a paper on the "Effect of Change of Acidity Upon the Rate of Diffusion of Tan Liquors Into Gelatin Jelly," John Arthur Wilson and Edwin J. Kern showed that the rate of penetration is a function of hydrogen-ion concentration as well as of the non-tannin content. A sample of gambier penetrated the jelly only at p_H values above 3.0, but a sample of quebracho only at p_H values above 4.7. Above 9.0 the quebracho penetrated more rapidly than the gambier.

Chemical Constituents of Skin

The chemical constituents of the skin were considered in some detail by Frank L. Seymour-Jones. Of the many compounds present in skin, collagen is the most important. Its chemical structure is still a matter of doubt. The fact that it hydrolyzes to gelatine would seem to indicate that collagen is the anhydride of gelatine. Gelatine when heated yields a substance resembling collagen, but this product does not hydrolyze again to gelatine.

Properties of Enzymes

Joseph Turney Wood, director of Turney Bros., Ltd., of Nottingham, England, contributed a paper on "Properties and Action of Enzymes in Relation to Leather Manufacture." Enzymes apparently differ from inorganic catalysts in that they may start a reaction as well as simply accelerate it.

Enzymes are encountered at many stages in leather manufacture. Those in the soaks and limes are mainly of a proteolytic nature. Many varieties are found in dung bates and commercial bates usually contain pancreatin.

In the drenching process the presence of an amylolytic enzyme is essential. Starches are transformed into dextrine and glucoses, which are subsequently fermented into organic acids.

A Critical Study of Bating

Through the use of the microscope and the hydrogen electrode, John Arthur Wilson and Guido Daub have obtained evidence which proves conclusively that the functions of bating are two—reduction of the skins to a condition of minimum swelling and solution of the elastin. The removal of elastin, which is the primary function of bating, results from the digestive action of the pancreatic enzymes in the bate. Elastin digestion may be followed microscopically by selective staining.

Experiments with pancreatin on strips of limed and unhaired calfskin gave the following results:

Elastin removal depends upon the hydrogen-ion concentration of the solution. With a solution containing 0.1 g. pancreatin per liter complete digestion of elastin was effected only when the p_H value of the solution lay

between 7.5 and 8.5—a very narrow margin—but when the concentration was increased to 1 g. per liter the active range was extended to 5.5 to 8.5.

The rate of elastin removal is a function of the concentration of enzyme and of the time of digestion.

Ammonium chloride shows an activating effect in concentrations up to 0.5 g. per liter and a marked inhibitory effect in higher concentrations. It was thought that this latter observation might explain the negative results obtained with several commercial bates. Accordingly samples of commercial bates were dialyzed in order to remove NH_4Cl, earlier experiments having shown that dialysis had no effect upon the activity of pancreatin itself. The results were still negative, however. It was then found that the woody fiber used as a filler in the commercial bates adsorbed the enzyme so strongly that it was unable to function.

From tests made with calfskin, the authors conclude that the value of bating depends entirely upon the properties desired in the finished leather. By applying the principles outlined in this paper, complete scientific control of the bating process is now possible.

Isoelectric Point of Collagen

Experiments by Arthur W. Thomas and Margaret W. Kelly indicate that the isoelectric point of collagen is at a hydrogen-ion concentration of 10^{-5} mols per liter.

Physiological and Histological Observations on Skins

A paper on "Physiological and Histological Observations of the Flayed Skin Entering Into the Art of Leather Manufacture," by Alfred Seymour-Jones, was read by his son, Frank L. Seymour-Jones.

The true skin consists of four distinct layers, differing considerably structurally and chemically.

The topmost layer is the grain membrane, which varies considerably in feel and texture with different animals largely according to the type of hair or wool. Just below it lies a thin layer, the cutis minor, vitally important in the manufacture of good leather. Below again is the fatty layer, largely consisting of groups of fat cells, resembling in appearance bunches of grapes. The last layer is the cutis major, which forms the major part of the whole skin. It is composed of white collagen fibers, intertwining in every direction to form a firm and inextensible coat for the body.

In the grain membrane and cutis minor the white fibers are supported by yellow elastic fibers. When, as in bating, the elastic fibers are removed, these two layers become soft and extensible, and the skin "falls."

The Chemistry of Lime Liquors

W. R. Atkin, instructor in the chemistry of leather manufacture at the University of Leeds, extended the theories of Procter and Wilson and of Loeb to the alkaline swelling of hide in lime liquors. The real reason why such sharpening agents as sodium sulphide and sodium carbonate produce greater swelling than lime alone is that the osmotic pressure which causes swelling is greater for sodium collagenate than for calcium collagenate at the same p_H value. The smooth grain of skins unhaired in limes containing arsenic sulphide is due to the fact that calcium collagenate only is formed.

Determination of Tannin

John Arthur Wilson and Edwin J. Kern have succeeded in improving the procedure of their new method of tannin analysis. The revised procedure gives the same results as the original, but saves a great deal of time and labor and increases the accuracy for unskilled analysts. To make a determination by the revised procedure, it is necessary merely to shake a fixed amount of hide powder with a solution containing a known amount of the soluble matter of the tanning material until all tannin is removed from solution, washing the tanned powder in a special device which prevents the loss of anything but matter in solution, drying the washed powder and weighing it. The increase in weight of the dry hide powder is a measure of the tannin content.[1] All criticism raised against the new method thus far has been refuted.

Through the Tannery on the Inside of a Calfskin

This lecture by John Arthur Wilson consisted of a series of remarkably beautiful sections of calfskin projected upon the screen at a magnification of 2,000 diameters, thus permitting a detailed and critical study of the changes at each stage of the tanning process.

In fleshing, the adipose tissue is cut away just under the flesh layer of elastin fibers. During liming, the substance of the malpighian layer of the epidermis is slowly digested, thus effectively separating the corneous layer of the epidermis and the hairs from the dermis. In bating, the elastin fibers are digested by pancreatic enzymes. After bating, only the grain membrane, collagen fibers, erector pili muscles and a few blood vessels are left. The tannin combines chemically with the collagen fibers. The fat-liquoring process distributes oil uniformly over the surfaces of the fibers. Coloring and the application of finishing materials complete the process of addition.

Astringency of Vegetable Tanning Extracts

The reasons for the different degrees of astringency of various vegetable tanning extracts have been long a matter for speculation. The problem has been attacked from a colloid chemical point of view by Arthur W. Thomas and Stuart B. Foster, with the result that astringency has been indicated to be a function of the electrical charge of the tannin particles. The higher the charge the greater is the astringency.

Action of Vegetable Tanning Materials

A paper by Arthur W. Thomas and Margaret W. Kelly on "The Time and Concentration Factors in the Combination of Tannin With Hide Substance: 1, Gambier, 2, Quebracho," was the first of a series of studies of the action of vegetable tanning extracts in the formation of leather. It brings out clearly the difference in behavior of an astringent tanning agent and of a mild one. Gambier shows slow regular increase in the amount of tans fixed by hide as the concentration of the extract and the time of reaction are increased. Contrasted to this behavior, quebracho shows a rapid and larger amount of tan fixed than gambier does, accompanied with a sharp maximum followed by an abrupt drop in the fixation.

Election of Officers

At the business meeting, the following officers were elected: John A. Wilson, chairman; J. S. Rogers, vice-chairman; Arthur W. Thomas, secretary-treasurer; F. Seymour-Jones and C. R. McKee, executive committee. It was voted to hold the next meeting of the division in connection with the 1922 fall meeting of the society.

[1] For full details see *J. Ind. Eng. Chem.*, vol. 13, p. 772, September, 1921.

Division of Sugar Chemistry

The Division of Sugar Chemistry met Wednesday and Thursday, C. A. Browne, chairman, and Frederick Bates secretary. A number of the papers presented were of a general interest nature, and others dealt primarily with improvements in analytical methods.

Some Studies on Decolorizing Chars.—Dr. C. E. Coates discussed in a general way the work on decolorizing chars at the Louisiana State University and the Sugar Experiment Station. Many inexpensive raw materials are to be found in Louisiana, and much investigational work has been done on these for the purpose of developing satisfactory methods of manufacture.

The Comparison of Various Blacks Upon the American Market.—C. E. G. Porst and J. M. Krno in their paper on the comparison of various blacks upon the American market stated that the efficiency of various carbons in decolorizing glucose liquors was determined by comparative laboratory tests in which not only the initial but also the total decolorizing power was considered. They also studied the relationship between fineness of mesh and decolorizing efficiency.

Adsorption Isotherms of Some Decolorizing Carbons.—F. W. Zerban and S. Byall using various commercial carbons and blackstrap molasses, made experiments to determine whether decolorization follows the adsorption formula of Freundlich. A Hess-Ives tintometer was used, and Mead's units for expressing the color. Different curves were obtained for different concentrations of molasses.

Decolorizing Carbons and an Inquiry Into Fundamentals of Sugar Colorimetry.—H. H. Peters reported the results of his studies on the decolorizing efficiency of several carbons. The author used optically clear filtrates for the determination of remaining color. It was pointed out in the discussion that there is need of an absolute method for measuring color, but very great difficulty in developing such a method.

Mechanical Clarification of Cane Juice Liquors.—A. S. Elsenbast spoke about the growing use of filter aids, such as Filter-Cel, and the results obtained in factory practice in Louisiana during last year's grinding season were given in considerable detail.

Rôle of Fermentation in the Deterioration of Cane Sugar Products.—C. A. Browne, C. A. Gamble, G. H. Hardin and M. H. Wiley have studied the rôle of fermentation in the deterioration of cane sugar products. Analyses were made of molasses, soft refined sugar and various grades of raw sugar. The average moisture content and percentage of invert sugar were higher for the deteriorated sugars. Slow inversion, with subsequent destruction of invert sugar by the micro-organisms associated with deterioration is apparently the explanation. The best remedy is believed to be more thorough drying.

Purification and Concentration of Enzyme Solutions for the Rapid Analysis of Sugars by Enzymotic Hydrolysis.—A method for preparing highly active enzyme solutions of great stability was described by F. W. Reynolds. The process may readily be adapted to the manufacture of enzymes on a large scale, and therefore encourages the more widespread use of the enzyme method of analysis.

Precipitation of Gum From Beet Molasses.—H. S. Paine and C. F. Walton, Jr., described a small-scale process developed primarily for the purpose of preparing sufficient beet gum to permit a study of its properties. The difficulty in eliminating this non-sugar economically on a factory scale, either by precipitation or by adsorption by decolorizing carbon, was strongly indicated.

Chemical Properties of the Gum From Cane Affected by Cobb s Gumming Disease and Its Influence in the Sugar-House.—C. F. Walton, Jr., and O. S. Keener reported their observations in Porto Rico. They stated that the real remedy without question would seem to be the eradication of the disease in the field. A purified solution of the gum was found to be optically active, but since it was completely precipitated by basic lead acetate, as in the usual method of analysis, the inference was drawn that the presence of the gum in cane juice does not interfere with the laboratory analyses.

Officers Elected

The following officers were proposed by the nominating committee and unanimously elected by vote of the members present: Chairman, S. J. Osborne; vice-chairman, F. W. Zerban; secretary and treasurer, F. J. Bates; executive committee: C. A. Browne, C. E. Coates; W. D. Horne, W. B. Newkirk, H. S. Paine, H. E. Zitkowski. A rising vote of thanks was given Dr. C. A. Browne, the retiring chairman, for his service to the section.

Section of Cellulose Chemistry

The meetings of the Section of Cellulose Chemistry were held Wednesday and Thursday, Sept. 7 and 8, under the chairmanship of Harold Hibbert, with G. J. Esselen, Jr., as secretary. Among the papers presented were the following:

A preliminary communication by Walter Russell and Louis E. Wise on "Acetolysis of Wood Cellulose" indicated a mode of attack on the question of the "normal cellulose" content of wood pulp and led to a discussion as to the reason why nitrated pulp cannot be used for the manufacture of celluloid. It was apparent that a closer definition of so-called "normal cellulose" is necessary, and it is expected that the committee appointed to supervise the manufacture of pure cellulose for purposes of scientific research will give attention to the matter.

"The Constitution of Cellulose" was discussed by Harold Hibbert in the light of the recent work of Karrer and Widmer, Freudenberg, Irvine and Monier-Williams, the evidence of the two former investigators indicating the probable incorrectness of Hess' formula. An explanation was given, in the light of the Hibbert formula, of the connection between cellulose, cellobiose and dextrose in their various modes of transformation into one another, and the forecast made of the probable synthesis by workers in this field of a wide variety of new cellulose derivatives of industrial importance.

The paper by Alfred Tingle on "The Alleged Adsorption of Alumina From Solutions of Aluminum Sulphate by Cellulose" occasioned an animated discussion, most of which was apparently opposed to the negative view taken by the author, so that the details of the paper will be awaited with interest. One point developed in the discussion was the admission that no satisfactory titration method existed for the determination of the basic aluminum hydroxide in aluminum sulphate, a point which is to be investigated by those interested.

The rôle of cellulose in plant life was reviewed by R. W. Thatcher, two points being strongly emphasized: On the one hand the absence of cellulose splitting

enzymes in the early stages of plant growth and the other that cellulose serves one function only—namely, that of a structure-forming material.

The determination of methoxyl groups in wood-distillation products by L. F. Hawley and Subramanya Aiyar was a continuation of the Forest Products Laboratory investigation on the action of small amounts of sodium carbonate in increasing the yield of methanol in wood distillation. It is no secret that Hawley's process is now being tried out on the commercial scale and with promise of success.

The technique of preparing viscose solutions for laboratory experiments was given by W. O. Mitscherling, while some new light was thrown by H. E. Wilkie on the commercial possibilities of ethyl acetate as a solvent for nitrocellulose and cellulose acetate.

The question of the most suitable type of monograph on cellulose chemistry led to considerable discussion following the review contributed by Dr. Louis E. Wise. The chairman was requested to forward Dr. Wise's paper to Dr. John Johnston as representing in general the views of the section.

The committee on viscosity standardization reported favorable replies from fifteen out of eighteen different manufacturers. They recommended the adoption of the "dropping-ball procedure," the details to be worked out by the committee with facilities offered by the du Pont company.

The committee on preparation of standard cellulose suggested that Dr. Bjarne Johnsen be asked to have his method for cotton purification printed in one of the technical journals, reprints of which are then to be submitted to the members of the section for criticism and comments.

Both reports were adopted unanimously.

In view of the different analytical methods at present in use in cellulose investigations, a committee was appointed to report on the best available methods.

Section of Petroleum Chemistry

The meetings of the Section of Petroleum Chemistry were held Wednesday, Thursday and Friday, Sept. 7, 8, 9, under the chairmanship of T. G. Debridge, and with W. A. Gruse secretary. Of the sixteen papers presented seven constituted a symposium on emulsification problems in the petroleum industry.

No papers were read Wednesday, as all the time was taken up by discussions concerning just what the section could do to bring about work on the fields of research.

Dr. Van H. Manning, director of research for the American Petroleum Institute, took part in this discussion, pointing out the necessity for educational work and standardization of testing methods.

A number of subjects were listed, and it was decided that an effort be made to bring together the academic and the technical research men in such a way that university research work on the physics and chemistry of petroleum might be stimulated. Dr. B. T. Brooks pointed out the absence in this country of the benevolent activities of such a firm as the Nobel Bros. Co. in pre-war Russia, which subsidized a great deal of purely academic work and helped put Russian petroleum chemistry in the high position it occupied before the collapse of that country.

On Thursday morning Peter Kerr, of London, one of the Society of Chemical Industry visitors, presented a letter of greeting to the Petroleum Section from President J. S. S. Brame of the Institution of Petroleum Technologists. Mr. Kerr spoke briefly and was an interested participant in the sessions.

The program opened with a paper by E. M. Johansen on iodine and bromine values of petroleum products. Mr. Johansen presented a large amount of very valuable work on this puzzling question and recommended a new reagent.

Thomas Midgley, Jr., presented some observations on the polymerization of amylene. As cracked gasolines are more plentiful in our motor fuels and the removal of the gum-forming constituents therein more important, it is clear that we need to know more about the chemistry of the unsaturated compounds from which the gums are formed.

R. E. Wilson and D. P. Barnard, of the Massachusetts Institute of Technology, supplemented papers presented to the section at Rochester by one on total heats of motor fuels.

Symposium on Emulsification Problems in the Petroleum Industry

The symposium on emulsification problems in the petroleum industry drew much attention. The material which the oil producer knows as "B.S.", or bottom settlings, may contain from 20 to 80 per cent good oil, and many new fields, such as the El Dorado, in Arkansas, produce much of this material; in addition, it collects at the bottom of nearly every storage tank in the mid-continent and other Western fields.

Dr. L. W. Parsons presented a detailed study of laboratory emulsions made with Nujol and mono- and di-valent soaps as emulsifiers; the inversion of phases was studied and a definite concentration found for the salting out of oil-in-water emulsions.

Prof. T. R. Briggs, of Cornell University, discussed emulsions with finely-divided solids. The author showed antagonisms between different finely-divided solids paralleling those between the different types of soaps.

Dr. J. L. Sherrick's paper presented the idea that the active agent in making oil-field emulsions is a film of finely-divided silt or clay, carrying adsorbed asphaltic matter. There was an interesting correspondence between this paper and that of Dr. Briggs.

E. E. Ayers, Jr., discussed the common characteristics of petroleum emulsions. He remarked on the rather striking uniformity of oil-field emulsions, told why it is a mistake to try to break up an emulsion by heating with a closed steam coil, and touched on such new topics as resolution of emulsion by filtration through media which are selectively wetted.

Practical methods for resolving emulsions as now used in the oil fields were presented in papers by R. R. Matthews and P. A. Crosby and by Dr. Sidney Born. The former paper was confined to a particular kind of chemical process, while the latter covered briefly the electrical, chemical and thermal methods, as well as the use of the supercentrifuge.

In the discussion following the symposium, H. C. Eddy gave a detailed account of the Cottrell process as commercialized, and Dr. F. W. Lane explained recent developments in low-voltage resolution.

The last action of the section before adjournment was to vote that the question of making the section a division as soon as possible be taken up; it was generally felt that this action was justified by the continued interest shown in the meetings of the section and its rapid growth since its formation in the spring.

Welding; Particularly Hammer Welding

Brief Discussion of Various Modern Methods of Welding, Indicating Advantages and Limitations of Each, and the Field for Hammer Welding Heavy Pressure Vessels—Operations Necessary for Hammer Welding Steel Sheets

BY ERNEST EDGAR THUM

METALS can be joined together in many ways. Even after excluding the various mechanical splices, riveted, bolted or keyed together, two pieces of like or unlike metals may be joined by several methods so that their substance is continuous.

A few years ago "welding" meant blacksmithing; to city dwellers with broken automobiles it now means some mysterious manipulations with a harmless looking torch or a sputtering electric arc. Soldering and brazing are less like these operations, but they also join metals into a continuous substance. Welding, therefore, is rather a broad term if it is to include all methods of making metals cohere.

Molecular Cohesion Necessary for Welding

High heat is not always essential. An autogeneous joint can be made between two pieces of gold or lead by strongly pressing them together at room temperature. In some cases pressure is not needed if the temperature is high enough—notably in thermit or other methods of "fusion welding." Even tool steel may weld to a certain extent by heating freshly fractured surfaces in contact after wrapping the joint in platinum foil and heating to a low red. The main thing seems to be to get intimate contact—molecular contact in fact—between the two sides of the joint.

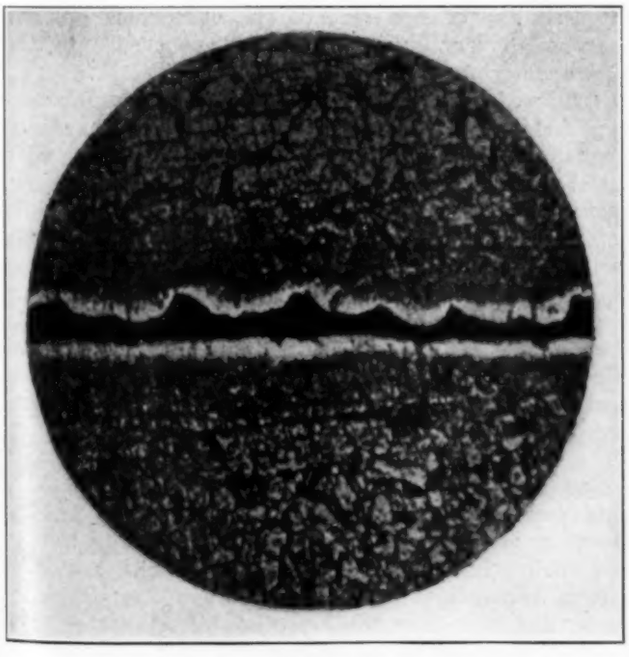


FIG. 1.
Section across soldered joint of two pieces of copper. Etched with ammonia. The solution of the tin in the copper is indicated by the light unattacked border along each side of the joint. Magnified 100 diameters.

When such a union is examined even under the microscope, it is very difficult to determine where the one piece stops and the other starts; there is a certain amount of actual interpenetration in all good welds. In fact the former junction surface is now crossed by metallic crystals, portions of which came from one piece of metal and portions of the same crystals from the other. Hence follows Stead's law of welding: "Unless the crystals become common to the two pieces there is no welding."

Heat is undoubtedly the handiest method of securing such molecular interpenetration. As noted above, many modern methods use heat alone, actually melting the metal at the joint, just as in soldering. However, heating to high temperatures is accompanied by two major difficulties: Even the best and purest metals are subject to rapid and profound physical changes at elevated temperatures; furthermore their chemical activity is enormously increased. The former rearranges the crystalline structure of the underlying layers of metal with an accompanying change in strength and ductility. The latter difficulty is responsible for rapid oxidation of some major component of the alloy being welded, and the resulting oxide must be got rid of in some manner or the joint will be unreliable.

Soldering and Brazing

Such inherent disadvantages of high temperature may be dodged by soldering and brazing.[1] Here the cleaned surface is covered with a thin film of fusible solder so selected as to form low-melting alloys with the underlying piece at the moderate temperature employed (Fig. 1). Thus a true weld is formed between piece and solder. Two pieces, prepared in the same way, are then held together, merely warmed to the melting point of the solder, and presto, they are joined.

Unfortunately, all low-melting alloys now available for soldering are deficient in strength. The joint is by no means as reliable as the pieces joined. It has an entirely different chemical and metallurgical nature, and can never approach the welder's ideal—to produce a joint which cannot be located because it is exactly like the pieces joined. In avoiding the dangers of oxidation, even greater chemical heterogeneity is produced.

Classification

A workable compromise between high heat and no pressure and no heat and high pressure has been used since prehistoric times by the worker in wrought iron.

[1]Grotts, "Metallography and Heat-Treatment of Metals Used in Aëroplane Construction," CHEM & MET. ENG., vol. 19, pp. 317, 583.

Only in comparatively recent years, however, have inventors provided other methods of producing heat than an open fire; these have been utilized in new welding methods. Excluding soldering and brazing, the following is a somewhat loose classification of the important ways of making coherent metallic joints in iron and steel, and their principal uses.

Class	Principal Utility
Electric Resistance Welding	
(1) Butt welding	Bars and wires
(2) Spot welding	Lap seams
Fusion Welding	
(1) By electric arc	Butt seams
(2) By gas flame	Butt seams
(3) By thermit	Heavy castings, shafting and forgings
Forge Welding	
(1) In smithy	Bar iron and steel
(2) By special machinery	Heavy tanks and pipe

Electric-Resistance Welding

Electric-resistance welding utilizes the fact that even though good conductors of electricity, metals offer some resistance to its flow. In overcoming this resistance heat is generated. If now a sufficient electric current can be concentrated and forced to cross a joint to be welded, the joint can be heated to a temperature where moderate pressure will cause a true weld.[2] Practically all metals and a great many alloys can be welded by this process, as well as combinations such as brass to copper, silver or gold, mild steel to tool steel, steel to platinum. It is not suited for cast iron. Metals of relatively low melting point, zinc, lead, tin and aluminum, may be welded by taking the proper precautions; even magnesium has been welded.

As noted in the classification, two principal methods of resistance welding are in common use. The usual butt-welder consists of a pair of heavy copper vises

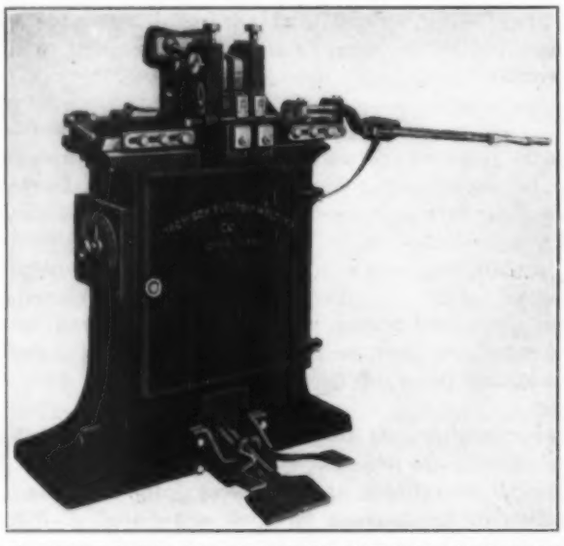


FIG. 2. BUTT WELDING MACHINE CAPABLE OF WELDING STEEL PIECES UP TO 0.5 SQ.IN. CROSS-SECTIONAL AREA

(Fig. 2), one fixed and the other on a slide so it can be thrust toward the other at the moment of welding. The two bars to be joined are shown clamped (abutting about midway between vises) and serve as part of the secondary circuit of an alternating current transformer built into the base of the machine. A small amount of current is drawn from the supply line, transformed into low-voltage, high-amperage current flowing through the iron bars, heating them to the correct temperature. Pressure applied by the hand lever through the movable vise then forces the hot plastic metal into molecular contact, upsetting it a little into a rounded bulge. If the pressure and current are held a longer time some white-hot metal is extruded as a perpendicular fin. Cooling takes place immediately after the current is shut off. The weld is usually annealed by a low current, and excess metal pressed down or the flash cut off.

This is in every respect the best way to join rods or bars end to end, especially in repetitive work on material less than 2 in. diameter. Fencing and cables can be made of endless wires, by merely butt-welding

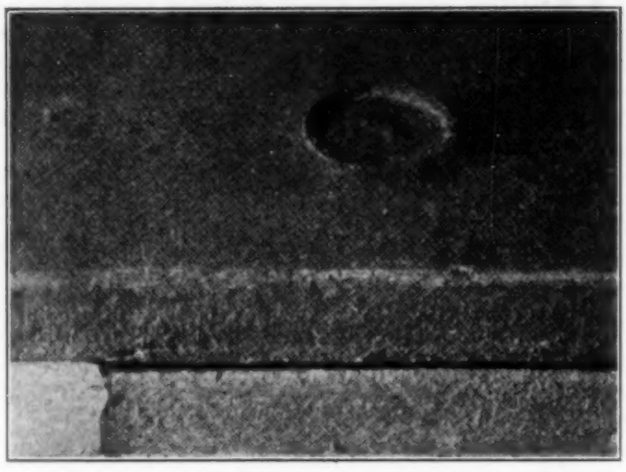


FIG. 3. CRATER FORMED BY SPOT WELDER WHEN JOINING TWO STEEL SHEETS

successive coils. Forged ends or steel of special analysis can be welded to stock rods. Other manufacturing processes readily suggest themselves.

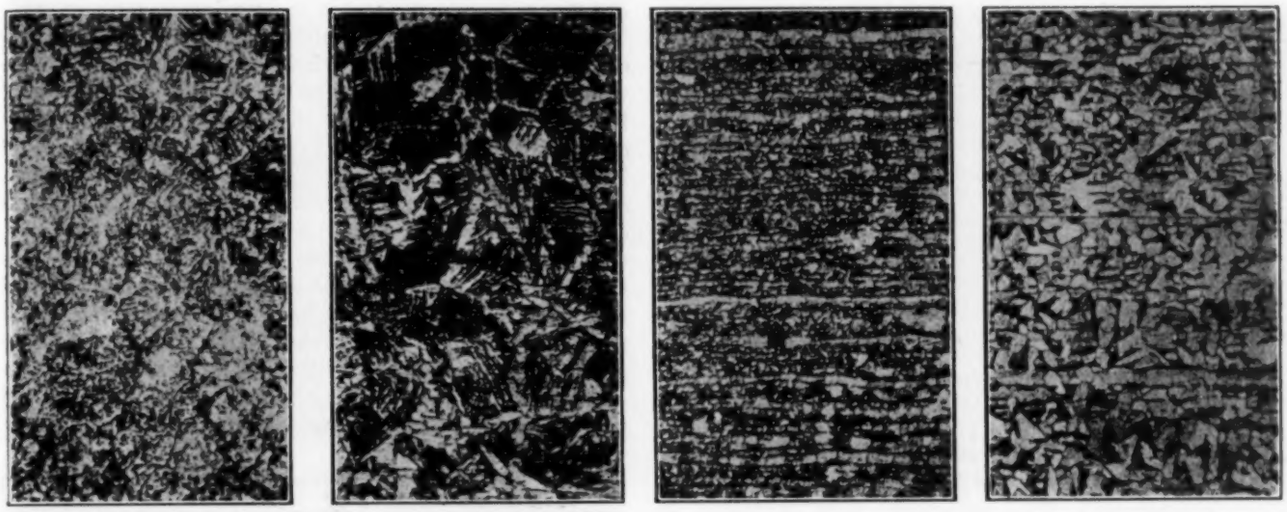
It is necessary to anneal these welds if they are to withstand shock, since the metal at the joint is heated intensely in the few seconds the current is on, and then cooled very quickly (in fact "quenched") by the cold underlying metal.

This means that the bar at the weld and for perhaps half a diameter on either side is in a hardened condition; its strength and brittleness increase with the carbon content of the stock. The heat is extremely short and under close control, however, and there is no excuse for extreme grain growth, "burnt" steel, slag inclusions or blow-holes. Unfortunately, the operation is in the open air, and high-carbon steel will lose up to one-half its carbon content throughout a thin layer at the weld. It is not necessary to dilate upon the harmful effect of this decarburization, despite any subsequent heat-treatment.

Spot and Percussive Welding

Spot welding uses the same electrical principles to weld small areas and to replace rivets when joining sheets or shapes. Imagine a yoke riveter with "snap" and "dolly" replaced by thick copper pencils, and with correct connections for high amperage electrical currents, and you have the essentials of a spot riveter. Two or more pieces are assembled and squeezed between these copper terminals and sufficient current passed across the joint to weld the adjacent surfaces over a small area, somewhat larger than that of an

[2] See "Electric Welds," by E. E. Thum, CHEM. & MET. ENG., vol. 19, p. 301 (Sept. 15, 1918).



FIGS. 4 TO 7. MICROSCOPIC STRUCTURE OF ARC WELD (RUDER). ALL MAGNIFIED 75 DIAMETERS

Fig. 4. Deposited metal at center of weld. Fig. 5. Coarsened grained adjoining weld. Fig. 6. Refined zone adjoining Fig. 5. Fig. 7. Original plate unaffected by heat.

appropriate rivet (Fig. 3). Pressure and current are then released, and the work shifted for another "spot."

It is rather strange that so excellent a process has not been put into as wide use in structural and plate work as it has in the manufacture of racks and gratings. Plain pieces of plates and angles can be stitched together without the labor of templet making, laying out, punching, reaming and rivet heating. The method makes a weld over a small round area which approaches the ideal; if the plates are clean there is very little decarburization, no blow-holes or slag, while the hardening caused by rapid cooling of the spot by surrounding cold metal is of minor moment in a connection between mild steel pieces.

The electro-percussion method depends upon sending a heavy current from a highly charged condenser through the points of contact of the metals to be welded at the instant they touch as they are brought together with more or less impact. The intense heat is developed so quickly that it is confined to the surfaces as they fuse together. It is used a great deal for joining wires and can be employed for practically all metals and alloys as well as for combinations. One of its chief uses at present is the uniting of copper and aluminum wires, which can be done in no other way with uniformly satisfactory results. Metals of widely varying melting points—for example, tin and platinum—can be welded by this means. It also finds many applications in the jewelry trade. The method has not yet been developed for anything but small pieces.

Fusion Welding by Electric Arc

Fusion welding, as the words imply, utilizes a much higher temperature than will produce the pasty state needed for resistance welding. The material at the joint is actually melted. Thus it is like soldering. It is further like soldering in that a space between the pieces is filled with fresh metal, seldom of the exact composition as that which it joins.

Either an electric arc or certain gas flames may be used to produce enough heat for local fusion. Such welds are usually made by filling up a notch or corner between the two pieces with molten steel, added a little at a time.

If the work is grounded and an arc struck from a steel wire, a small spot is raised to incandescence and builds up liquid metal acquired from the electrode. Metal is transferred through the arc, partly as a true vapor, partly as hot particles driven off by explosive expansion of gas occluded in the wire, but mostly as larger droplets, melted from the end. Such a deposit is gradually built up in layers, until the joint is filled from end to end. In view of the fact that the arc is a region of intensely hot gases (oxygen, nitrogen and iron) mounting up to 3,500 deg. C. or more, it is not surprising that the deposited metal will have lost much of its carbon, silicon and manganese and acquired oxygen and nitrogen. As ordinarily made at the present time it is in fact a low-carbon casting (Fig. 4) made and cast continuously under unfavorable conditions, containing many blow-holes and unusual compounds, whose specific effect is not as yet thoroughly explained (Fig. 8). Rawdon and others at the Bureau of Standards have cut test-bars from heavy deposits of weld metal[3] made from low-carbon iron and steel welding wires and find that while possessing fair ultimate strength (50,000 lb. per sq.in.) it is likely to be quite deficient in ductility.

Great variation existed in these tests; the best ultimate strength was 54,500 lb. per sq.in., the highest yield point 36,250, the best elongation 15.0 per cent and the best reduction in area 23.0 per cent. It seems fair to conclude, therefore, that perfection of operating methods and increase in operator's skill will result in much better fusion welds than have been made in the past. The use of proper alloy steels as welding wires is a line of development which as yet has been hardly touched, but holds out promise of successfully making weld metal of high strength and toughness.

Unfortunately there is little opportunity for working or heat-treating these welds—they are usually performed on fixed objects, or as emergency repairs and must ordinarily be used as made. Actual fusion of the original metal at the weld causes other metal in the immediate vicinity to be overheated, resulting in a coarsening of the grain with its characteristic ferrite envelopes (Fig. 5). This state of affairs, accompanied

[3] See Rawdon, "Physical Properties of Arc-Fused Steel," CHEM. & MET. ENG., vol. 23, p. 677 (Oct. 6, 1920). Also Bureau of Standards Technologic Paper 179.

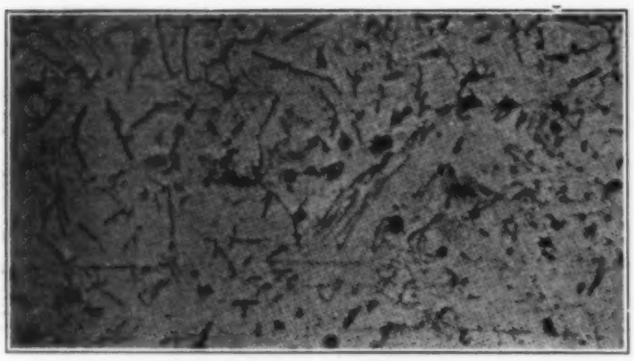


FIG. 8. ELECTRIC ARC WELD IN ¾-IN. BAR STEEL. × 600. (MILLER)

as it is by oxygen penetration, reduces the ductility and resistance to shock, and induces intergranular fracture; consequently if a well-made weld is tested to destruction it would probably fail in the underlying layers, rather than in the weld.[4] Such physical defects, if not too pronounced, can be cured by proper heat-treatment—in fact, they are partly corrected in a crude and uncontrolled way by the heat of successive passages of the arc, a factor difficult to appraise (Fig. 6). Extensive and accurate heat-treatment probably combined with mechanical work would be necessary to correct the major defects of a fusion weld.

On account of the nature of the radiation from the arc, it is necessary that the operator be carefully protected. Simply shielding the eyes is insufficient, the head and hands must be protected from the ultraviolet rays which form a large proportion of the radia-

FIG. 9. PIPE JOINT BEING MADE BY GAS WELDING. (OXWELD ACETYLENE CO.)

tion emitted by the arc. A special glass window which not only shields the eyes from the heat and intense light but also cuts out the ultraviolet (invisible rays) is a necessity.

Many of the same difficulties beset welding with a gas flame, commonly acetylene burning in pure oxygen. The temperatures are 1,000 deg. less,[5] but still far above the melting point of iron or steel, and in a range where oxidation is rapid and excessive. Metal is filled into the notch by melting off the end of a wire, held close to the work (Fig. 9). Fortunately the liquid iron is somewhat protected from atmospheric oxygen and nitrogen by a rather thick "envelope" flame. It is commonly known that a typical oxyacetylene torch produces an inner cone of white-hot carbon burning to CO. Outside this is the envelope of burning CO and H, which spreads out and heats the underlying metal for some distance on all sides. Due to this extensive spread, gas welding overheats the work more extensively and is perhaps less suitable for thick plates or structures which are rigid and may be buckled by

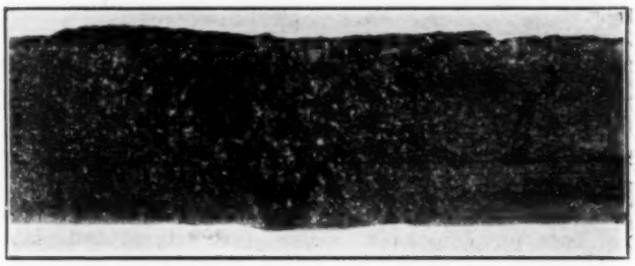


FIG. 10. WELD MADE IN MILD STEEL, ETCHED WITH AMMONIUM PERSULPHATE. FULL SIZE

the heat than the electric arc, but it is more suitable for cast-iron[6] or thin steel sheets. But even at best the weld metal is a casting, it contains more or less oxide, and the underlying grain is severely coarsened. Figs. 4 to 7 are typical of the microstructure of all untreated fusion welds; they comprise a central portion of deposited metal, bordered by original metal reheated to various degrees. All metal heated beyond the critical temperature has recrystallized, resulting first in a refinement (Fig. 6) or coarsening (Fig. 5) as the heat goes up. In gas-welded plates the distance from the edge of the filled-in metal to the unaltered stock will equal four times the thickness of the plate, while such a zone is confined to ⅛ in. in an electric weld.

Figure 10 is a macrograph of a weld made at the Union Carbide and Carbon Research Laboratories in mild steel with a low carbon filler rod, later cut, polished and etched with ammonium persulphate. Disregarding the long "ghost," the clean even line at the weld junction, and the solid, homogeneous nature of the filled metal shows what can be done by a skilled operator. Fig. 11 shows test pieces bent back upon themselves, with the bottom of the V-notch inside, and Fig. 12 is the microstructure at the original edge of the plate.

Many of the remarks made under electric arc welding about variation in strength of welds and weld metal depending upon the operator's skill apply with equal force to variation in the quality of gas welds. The Union Carbide and Carbon Research Laboratories have made many tests on bars cut from deposited metal, the welding being done under a wide variety of conditions, and find that the resulting deposit possesses quite uniform physical properties when made by reliable workmen. Typical results of metal de-

[4]Rawdon reports tests on ten superior welds averaging an ultimate strength of 55,650 lb. and elongation of 7.5 per cent. The best broke at 59,470 lb. per sq.in. and the best elongation was 14 per cent. These joints were in ship plates having an ultimate strength of 68,000 lb. per sq.in. and elongation of 22 per cent.

[5]Bureau of Standards Letter Circular VIII-8 gives the temperature of the oxyacetylene flame as 2,400 deg. C., and the oxyhydrogen flame as 2,000 deg. C.

[6]Cast iron must be preheated.

FIG. 11. COLD BEND IN PLATES WELDED BY OXYACETYLENE FLAME

posited from well-known filling rods follow; each figure representing the average of five:

Metal	Ultimate Strength
No. 1 Filler	55,600 lb. per sq.in.
No. 2 Filler	59,340 lb. per sq.in.
No. 3 Filler	64,500 lb. per sq.in.

Either the arc or flame weld is very good for repairs on parts enduring static loads which have a considerable excess of strength or for building up worn or missing metal. An oxyacetylene outfit especially is portable and if necessary may be taken to the work rather than *vice versa*, and with another torch supplying a separate stream of oxygen can be used for cutting metals as well, thus making it a most useful shop tool. It is also used for welding copper and its alloys, aluminum and its alloys, malleable and cast iron. Under the name "lead burning" it is used for welding lead pipe, sheet lead, etc. It is only necessary to protect the eyes with dark glasses, as shown in Fig. 9, owing to the lower actinic value of the flame as compared to the radiations from an arc.

As is well known, much work was done during the war to determine whether fusion welding could be used in hulls to replace riveting, but it has not found great favor among shipbuilders or boiler makers, except to fix small fittings, probably due to the fact that so much depends upon the skill and care of the workman, and the difficulty of inspection. Besides repair work it is largely used for manufacturing low-pressure tanks and barrels, structural tubing and for sheet or seam welding wherever met with.

FIG. 12. MICROSTRUCTURE OF FILLED METAL NEAR ORIGINAL EDGE OF PLATE, ETCHED WITH 5 PER CENT. HNO_3 IN ALCOHOL. × 100

Welding With Thermit

Fusion welding may also be done with thermit. A thermit crucible is nothing more than a small furnace producing steel by the reaction between finely divided aluminum and iron ore,

$$Fe_2O_3 + 2Al = Al_2O_3 + 2Fe.$$

The aluminum burns in the oxygen from the ore, producing sufficient heat to liquefy the whole mass, which is then tapped directly into a sand mold formed around the broken casting (Fig. 13). The broken ends have previously been heated by a torch and at the moment when the white hot liquid metal arrives are themselves at a red heat, and actual melting takes place for a slight depth.

Since the added metal may be alloyed or carbonized to suit, and molding and casting are done by exactly the same principles as those underlying steel founding,

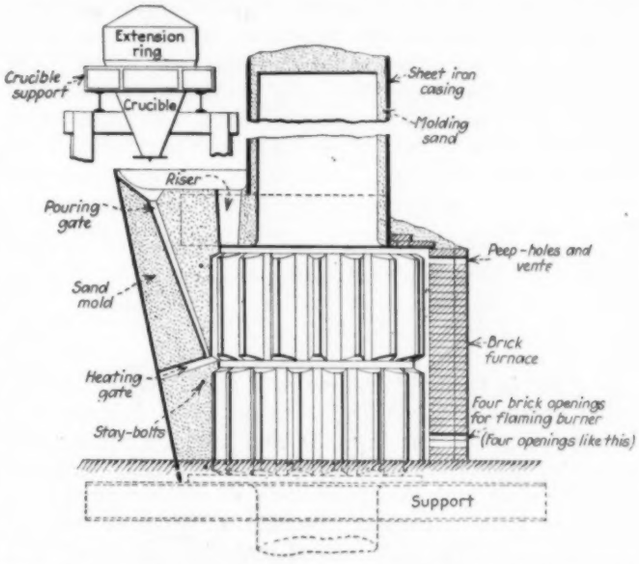


FIG. 13. ASSEMBLY OF EQUIPMENT FOR REPLACING BROKEN TOOTH ON A HEAVY PINION BY THERMIT WELDING

it follows that a well-made thermit weld may have the same composition and structure as the steel casting it joins. Care, of course, must be exercised to prevent any slag contamination, or oxidation or carbonizing at the solid ends during preheating. There will also be a grain refinement in any adjacent metal which has been heated above the critical temperature; but this is an improvement rather than a detriment.

Without doubt, thermit welding is the best method for repairing heavy steel castings. It is also the only practicable method for extremely heavy forgings. Its use here presents the obvious deficiency that two forged pieces are joined by a casting. Even though the chemical composition may be the same, it would seldom be possible to subject the joint to the work and heat-treatment necessary to make the repaired unit a homogeneous structure. Such an operation would probably cost as much and require more time than a new piece; consequently thermit repairs on forgings are best adapted for quick repairs on busy machinery whose broken part if a forging ordinarily works under a considerable margin of safety.

It may be inferred that these new styles of welding have not seriously encroached upon the wide range of hand work done in soft steel and iron by the expert blacksmith. With perhaps the single exception of butt welders, they have extended the usefulness of the welding operation to fields where it had seldom been employed. Thus, spot welding and fusion welding in their largest use replace riveting in plate work, while thermit negotiates tasks far too heavy for the ordinary forge shop. They all do work or join metals which would not be attempted by the blacksmith; on the other hand nearly all of them have drawbacks which limit their usefulness. For instance, butt welding is accompanied by deep-seated decarburization, arc or gas welding sticks on tabs of metal quite likely to be "gassy" and deficient in ductility. On the other hand, forge welding is limited to wrought iron or low-carbon steels. None of them have solved the problem of producing a safe, "seamless" pressure vessel, or one often subjected to wide variations in temperature or stress. A riveted tank working under those conditions will not remain tight even by most expert riveting and caulking. Instances are autoclaves, drums for cracking gasoline, and boxes for annealing light sheets. If some thoroughly dependable method for making such welded seams could be devised, undoubtedly a wide variety of pressure vessels, boilers and pipe will eventually be made in that manner.

Welding by Machinery

Consequently for some years, engineers at various places have been working on the problem of translating the art of the blacksmith to the modern factory with its labor-saving machinery of high power. There seemed to be no inherent obstacle preventing a 100 per cent joint in wrought iron or mild steel. Wrought iron when originally taken from the puddling furnace is a sponge of metal, yet it welds easily in the rolling mill or under a hammer into a tough, strong bar, composed of elongated strings of crystals of nearly pure iron together with a certain quantity of slag drawn out into threads. Yet this welded material has nearly the same tensile properties as open-hearth iron, cast liquid from the furnace and rolled exactly like steel products. In other words, particles of ferrite can be properly welded into a bar as strong as one of nearly pure ferrite, cast and worked from the ingot. Why, then, should not a welded joint develop an efficiency of 100 per cent?

One variety of thoroughly reliable machine-welding has been known for nearly a century and practiced in the manufacture of pipe or tubes, first of wrought iron and later of low-carbon steel. It is well known that small pipe is made by pulling white-hot "skelp" (plates of the correct width and thickness) through a die or bell having an opening of the exact size of the outside of the pipe, the bell at the same time forming the tube and pressing the edges into welding contact. Pipes larger than 3 in. are lap-welded. The skelp is scarfed on the edges, heated and bent into the approximate cylinder, reheated, and rolled at a welding temperature over a mandrel, and finally straightened before becoming cold. Such methods serve to make pipe up to 30 in. in diameter. These longitudinal seams are not as strong as the metal comprising the rest of the pipe wall, as shown in Table I. However, the characteristics of welded pipe as manufactured in modern plants are well known to the engineering profession, and they are as dependable as any other metallurgical product. One in five burst lap-welded tubes will be found to have failed by some defect in the pipe wall, rather than in the joint.

This digression is warranted as an indication that it is not unreasonable to extend further the principles of "fire welding" to hitherto untouched fields. Of course not all metals or even iron alloys can be welded by forging. Weldable metal must lose its brittleness, becoming soft and "sticky" some little distance below the melting point, or even the "burning" point—that temperature where some constituent is rapidly oxidized. Wrought iron is an excellent material for welding because it becomes soft (in this sense) 200 deg. below its melting point, and it may readily be heated to 1,400 deg. C.—100 deg. below its melting point—without danger of burning. This safety is in turn due to the fact that the metallic part of wrought iron is pure metal, and it contains only a minute amount of fusible eutectics which allow penetration of oxygen at high temperature, with consequent damage resulting in intercrystalline weakness. Furthermore, the contained slag undoubtedly melts and flows over the exposed metal surfaces, thus protecting them from oxidation, and dissolving any oxide which might previously have been formed. It is well known, for instance, that the welder, when making wrought-iron pipe, judges the correct temperature by observing when the white hot skelp becomes wholly covered with a glassy sheen—gets "greasy," as he says. This indication occurs at a definite temperature, and is quite apparent even to the unpracticed eye.

TABLE I. ULTIMATE STRENGTH OF PIPE WELDS

	— Steel Pipe[7] —		—Wrought Iron— Pipe	
	Butt-Welded Lb. per Sq.In.	Lap-Welded Lb. per Sq.In.	Butt-Welded Lb. per Sq.In.	Lap-Welded Lb. per Sq.In.
Average strength of metal	57,000	57,000	.....	.....
Average strength of weld	41,600	51,700	29,050	29,460
Maximum strength	58,160	59,540	.....	.....
Minimum strength	33,030	47,030	.....	.....
	per cent	per cent		
Average efficiency of joint	73	92	.....	.....

Ferrite itself oxidizes very easily and at low temperatures. Beginning at 200 deg. C. occur the iridescent "temper colors" known to the forge shop, really due to thin films of oxide. Oxide is brittle and unweldable at all temperatures and melts at 1560 deg. C., which is some 30 degrees above the melting point of pure iron. Therefore it can not be squeezed out of a hot weld unless fluxed into a fusible slag. Nor can it be left in the joint with impunity. Fortunately, low-carbon steel especially made for pipe welding acts very much like wrought iron as it approaches the welding temperature. It contains enough silicon, or picks up enough silica, alumina and lime from the furnace bottom, to lower the melting point of the scale to below the "burning" temperature. The pipe maker in this case also watches for the time when the skelp becomes "greasy," and immediately draws it into the welding die.

It is more than a coincidence that wrought iron, the smith's universal metal, is the metal which welds best and easiest. Wrought iron has always been made in crude furnaces, from which it is drawn as a spongy mass. Despite exposure to the air, it welds readily into a bar, tough and strong regardless of crude manipulation. Wrought iron is a weldable material from the first; if it were not capable of being welded

[7] R. T. Stewart, "Strength of Steel Tubes, Pipes and Cylinders Under Internal Fluid Pressure," *Journal*, American Society of Mechanical Engineers, April, 1912.

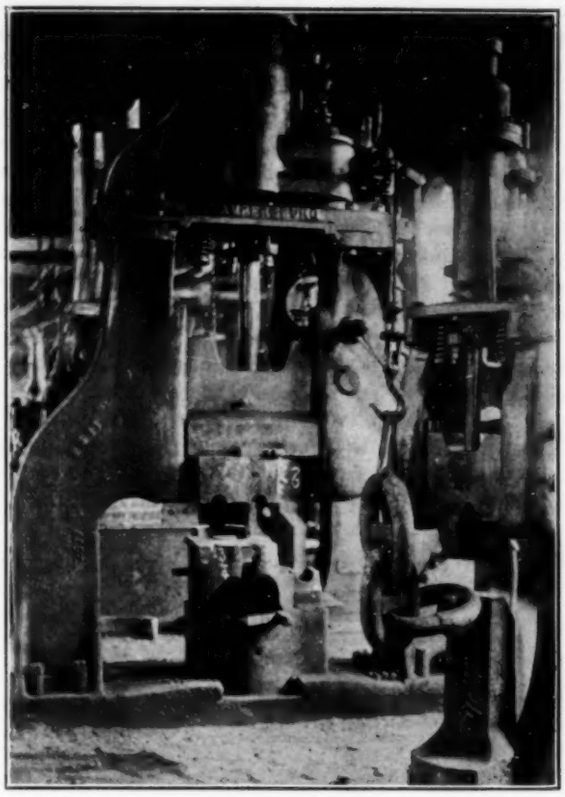


FIG. 14. WELDING HEAVY WROUGHT-IRON CHAIN IN DOLLY DIES AT THE BOSTON NAVY YARD

by the smith, it would never have been more than a useless lump, a conglomerate of iron and slag particles, a thing to be avoided rather than produced.

Soft steel is less easily welded, except when occasionally made with this end in view, but most of the so-called "iron" on the market in bars and pipe is really steel. It may not be heated so high—with increasing carbon the forging temperature is lowered, the pasty stage narrowed and danger of burning (by melting of some fusible segregates) increased. A high-carbon steel will "burn" before it loses its brittleness and before the scale can be fluxed into a fluid covering, and consequently is unweldable by this slow-heating process.

Efficiency of Forge Welding

In order to get an idea of the strength of commercial welds, Bauschinger's series of tests may be noted. He examined some carefully made welds, with the result that hand-forged welds of wrought iron gave an average efficiency of 87.9 per cent; when forged under the steam hammer they averaged 91 per cent of the strength of the original bar. With soft steel the hand-forged welds had an average efficiency of 84 per cent, while the power-forged welds developed 97.2 per cent. Hand-made welds have been variously reported to possess from 30 to 100 per cent of the strength of the parts joined, a great variation depending upon the skill of the smith, his methods and the difficulties of the job. Such great variation is doubtless responsible for the conservative attitude of various boiler codes toward welded joints. For instance, the American Society of Mechanical Engineers' code allows no more than 28,500 lb. per sq.in. as ultimate strength in a wrought joint in plate steel having a minimum strength of 45,000 lb. per sq.in., an efficiency of no more than 63 per cent. Welded pressure vessels are now regularly made which are guaranteed to have 90 per cent joints, and no difficulty is experienced in getting insurance underwriters to accept them at that rating. Tests to be quoted in a later article also show that 90 per cent is a conservative value for longitudinal seams in large piping.

That very high-grade work can be regularly done even with simple equipment is evident from the fact that hand-welded chain is universally regarded as being one of our most dependable tools. The problem is therefore to study the technique of hand-forging and to develop machinery which will prevent or minimize those occurrences which produce weak or variable joints.

A smith prepares his weld by upsetting or scarfing the pieces to be joined. He provides extra section so that it can be thoroughly hammered and yet not be undersize. He also shapes his pieces to be joined so that first contact during forging is over a relatively small area; the pieces are then gradually forced together, squeezing any fluxed oxide or slag out of the joint. He heats the parts in a clean fire, making sure that the metal is clearly heated through, yet without burning on the edges. When a proper heat is had, he dashes on a certain amount of sand, places the pieces one against the other on the anvil, holds them firmly in place and quickly and vigorously hammers them together, continuing the work on the weld and on the hot regions abutting until the metal has passed through the recalescence temperature, when danger of grain growth no longer exists.

A mechanical welding operation, simulating hand-forging, must therefore heat the pieces rapidly to the correct temperature without oxidation, and quickly hammer the hot metal together, continuing the work through recalescence. Transfer of tools or heated metal must be very rapid. The work must be firmly held. Finally the completed article must be bodily put into an annealing furnace, to relieve internal strains and refine the grain.

It must remove as many as possible of those empirical conditions which are so difficult to control in hand-work and which make it remarkable that so many welds are good, not that a few are very bad. A weld may appear under certain test conditions to be actually stronger than the welded part, but that is because the adjacent parts have been badly overheated and not hammered, or because the joint has been carburized by the fire. Both of these conditions are due to negligence, and cause an amazing paradox—the less skillfully the welding is done the better the weld may appear to be.[8]

Chain Welding

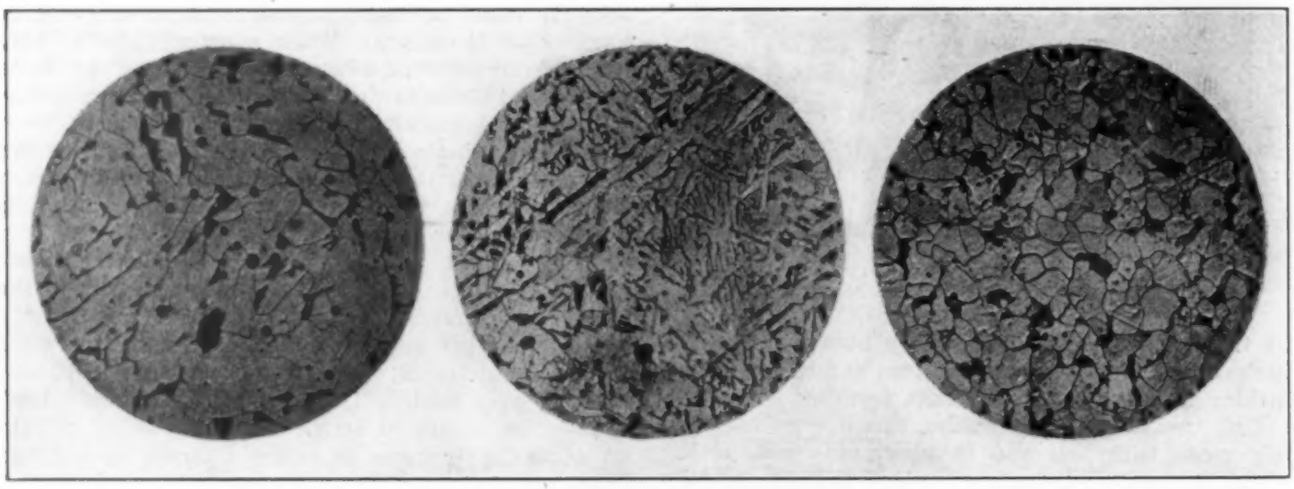
A correct method was worked out and introduced in the Boston Navy Yard in 1914 for hammer welding the heavy chain cables used in the U. S. Navy.[9] Briefly the process is as follows: The bars of double refined wrought iron, up to 3¼ in. diameter, are sheared to the length necessary for one link, one end heated in an oil-fired muffle, then taken to a press where it is upset and scarfed. The other end is then heated, upset and scarfed in the same manner. The whole bar is then heated, and bent into the shape of a link by a special bending machine, threaded into the end of the growing chain, and the scarfs closed under a heavy steam ham-

[8] "The Welding of Steel in Relation to the Occurrence of Pipe, Blowholes and Segregates in Ingots," by H. Brearley, *Jour. Iron & Steel Inst.*, 1921.

[9] C. G. Lutts, "Chain Cable by Power Welding"; *Trans.*, A.S.T.M., 1920 II, p. 81.

mer. The scarfs are then brought to a welding heat (about 1,350 to 1,450 deg. C.) in an oil-fired forge, and quickly removed while hot and dripping with slag and welded by drop forging under a fast-working 250-lb. steam hammer, as shown at the right of Fig. 14. Its final shape is given without reheating by dies under a heavy steam hammer in the background, the flash cut off with a chisel, the stud set in place and link closed in by the same hammer.

The use of heavy machinery in this manner permits much greater reduction during forging and a longer scarf than a hand-made chain, as well as less concentrated heat, and consequently a longer welded surface. Undoubtedly a better joint results. However, the tendency is to start and finish at a higher temperature, thus permitting the growth of a relatively coarse columnar grain (Figs. 15 and 16), closely related to that existing in overheated steel, especially in those regions containing an appreciable amount of carbon.[10] Pearlite



FIGS. 15 TO 17. MICROSCOPIC STRUCTURE OF POWER-WELDED ANCHOR CHAIN. (LIEUT. G. D. BARRINGER, U. S. N.)

Fig. 15. Usual appearance of metal at weld before annealing.

Fig. 16. Structure often associated with Fig. 15, differing in degree only.

Fig. 17. Structure of weld after annealing at 950 deg. C. and air-cooling.

then accumulates in angular patches between the elongated grains, the whole structure being definitely unreliable. It presents a minimum of grain interlocking, a maximum extent of crystalline cleavage planes, and is especially weak under shock or alternating stresses. Under tensile stress its most typical manifestation is a low yield point. (It may also be noted that Miller[11] finds that several brittle fusion welds had columnar grains.)

In welding chain links, this structure causes brittleness and stiffness. Under test the link is unable to stretch and adjust its shape, consequently it breaks in shear at the quarter points. If the completed chain is heated up to 950 deg. C. (requiring 3 hr. to get there) held for 10 min. at that temperature (slightly above Ac_3) and air-cooled, it restores equi-axed, normal sized grains shown in Fig. 17 and correct physical properties. The wrought iron from which the links are made at the Boston Navy Yard is quite irregular in carbon content, analyzing 0.05 to 0.08 per cent C, and containing patches two or three times as high. Consequently heat-treatment is much like that for low-carbon steel: the rate of cooling after annealing is important—furnace cooling results in softness and low strength.

Hammer Welding

Mechanical welding, extending the principles of hand-forging to the commercial manufacture of very large pipes and tanks, originated in Germany. Recognizing the advantages of seamless construction in many power accessories, heavy steam drums and receivers have been made in this country for the past six or seven years. The Continental Iron Works, of Brooklyn, have made large tubes for many years, their principal use being for corrugated fireboxes for marine boilers. The American Welding Co., of Carbondale, Pa., and the American Spiral Pipe Works, of Chicago, have also plants for hammer welding; the former specializes in gas containers and bottles, while the latter operates on comparatively light plate. More recently the Blaw-Knox Co. and the National Tube Co. have built modern hammer-welding plants in the Pittsburgh district for the manufacture of heavy seamless pots, tanks, pressure vessels and pipes of mild steel plate. Thus the process is gradually coming into use in this country, despite the rather meager amount of current information available about the methods.

It may readily be seen that though the principles involved and precautions necessary in forge welding of small bars, power welding of chain and hammer welding of plate work are the same, the fixtures are different, if for no other reason than adaptability to the shape and bulk of the work. In other words, whereas chain links can be rapidly swung from fire to hammer, a 10 x 20-ft. boiler must be held nearly stationary and the fire, hammer and anvil brought to it.

Briefly, the method is as follows: The various plates, bent or pressed to shape, are assembled with lap joints, and stitched together here and there by a short torch weld on the edge. The assembly is then placed on a carriage, joint up. A pair of gas flames are held one above the seam and the other directly below. When that region has been brought to a proper heat, the upper and lower torches are quickly replaced by an air hammer and anvil respectively, and the hot spot welded and

[10] "Heat-Treatment of Wrought-Iron Chain Cable," by W. W. Webster and E. L. Patch, *Trans.*, Soc. Mech. Engrs., 1916, vol. 38, p. 1159.

[11] "Path of Rupture in Steel Fusion Welds," Bulletin 146, Am. Inst. Min. Engrs., p. 311.

worked down flat. This cycle is repeated until the seam is welded continuously from end to end. When all the seams are finished, the whole article is annealed; all fixtures applied, and if it is a pressure vessel, it is subjected to hydraulic test.

Such operations can best be described by tracing the course of a job through the shop. This will be done in two subsequent articles, descriptive of the plant and practice of the Blaw-Knox Co. and the National Tube Co. respectively. However, it may be noted here that the excellence of well-made seams welded in this manner has been often proved and is now generally accepted. Various names for the process have been used, such as "forge welding," "pressure welding," "fire welding" or "horn welding." The Germans use the term "Wassergasschweisserei" (water-gas welding). But in all cases their distinguishing characteristic is that they describe a wrought joint, a joint guaranteed by its makers to develop at least 90 per cent of the strength of the plate.

Open-hearth firebox steel is quite suitable for hammer welding. The American Society for Testing Materials has issued tentative specifications[12] covering plates for forge-welded tank cars and similar containers. One of the leading manufacturers of seamless tanks feels that the chemical analysis, especially the silicon content, is very important, and insists on lower limits than the above-mentioned specification. The properties of this plate and a satisfactory weld are as follows:

Carbon	0.18 max. (no 25 per cent excess allowed)
Phosphorus	0.035 max.
Sulphur	0.035 max.
Manganese	0.40 to 0.60
Silicon	0.04 max.
Copper	0.04 max.
Nickel	0.05 max.
Chromium	0.05 max.

	Plate	Weld
Elastic limit	32,500	24,000
Ultimate, minimum	50,000	.....
average	52,000	48,000
Reduction in area	60%	40%
Elongation	26% in 8 in.	15%

Since the efficiency of a joint in lap-welded pipe is somewhat lower than that of hammer-welded seams, it is only natural that the weld would be easier to detect in the former. A polished section of lap-welded pipe usually has the weld line visible to the unaided aye, marked by fine specks of included slag. Hammer welds must ordinarily be deeply pickled with strong acid before showing a similar alignment of tiny pits. Fig. 18[13] shows the appearance after pickling of a hammer-welded plate. The utter elimination of slag inclusions is perhaps impossible, but in a weld having 95 per cent strength or more they must be held to the extreme minimum.

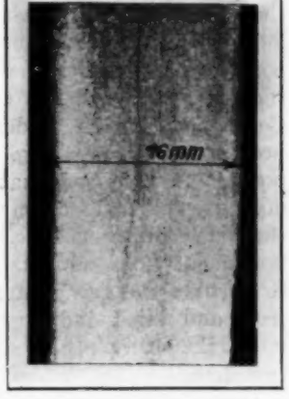


FIG. 18. LOW-CARBON PLATE WELDED AFTER HEATING WITH WATER GAS. × 1.5

Experience has shown that defective welds can be traced to (*a*) the welder, (*b*) the weld itself, (*c*) thermal disturbance in the stock. Labor-saving equipment in the hammer-welding plant evidently reduces the liability that the work will be slighted by the operator—his own personal equation is almost eliminated. Temperatures of the sheet can readily be controlled by pyrometer, the heating flame is clean and its composition under close control, while an air compressor assumes the labor of heavy sledging. Hence there is little excuse for wrong heat or insufficient work or dirty welds, those most prolific causes of weak joints. Finally, thermal disturbance in the underlying metal is reduced to a minimum by the concentration of the flame, by the ease with which the object is manipulated so that any desired spot can be worked under the hammer, and especially by the annealing given the completed piece. Under these conditions it is not surprising that a joint having much higher efficiency than a riveted joint is regularly produced.

Field for Hammer Welding

A great many common operations in the chemically controlled industries require dependable pressure vessels which are subjected to sudden and rather wide variations in temperature, and yet contain volatile substances which penetrate almost microscopic openings. Riveted stills, for instance, are continually being caulked. Again, annealing pots for use in sheet and tin plate works or wire mills must be subject to wide temperature ranges and yet be absolutely gas tight and free from those cracks which rapidly grow in cast boxes. Cyanide hardening pots are also exposed to severe temperature stresses and corrosive action. Cast vessels now in use are very expensive, brittle and unsafe against heavy pressure. Riveted joints are leaky and often present a concentration of metal where it is least desired. Hammer welding thus seems to have a certain exclusive field. Furthermore, it is of great promise in plain welding work and in manufacturing large-diameter hydraulic lines.

It is also obvious that welded pipe lines, with smooth interior surfaces, will carry a greater amount of fluid for a given pressure head than a line which is roughened by a multitude of rivet heads. This combines with the increased joint efficiency in making a very material saving in weight in pipe lines performing a specified duty on hydroelectric installations, irrigation and aqueduct lines, high-pressure fire lines, and conduits for air, gas and steam.

Hammer welding thus seems to have a certain unique application to the needs of modern industry not now adequately met by any other style of joint.

Commercial Possibilities of the South Sea Islands

Greater interest is constantly being manifested in the commercial possibilities of the South Sea Islands, according to a recent issue of the *World Salesman*. Hardware, including such articles as mugs, iron pots and pans, bedroom ware, and similar goods, is in constant and growing demand in Tonga. In Samoa American exporters have gained the trade formerly conducted by Germany, while in Tonga recent figures show that American firms are taking a good share of the trade, and in Fiji the steadily growing participation of the United States in the copra trade is paving the way for larger importation.

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[12] *Proceedings*, American Society for Testing Materials, vol. 19, part I, p. 150.

[13] Reproduction of Fig. 399, Bach and Baumann, "Konstruktionsmaterialien."

Glimpses of Ohio Ceramic Industries—I

Ohio the Largest Producer of Ceramic Ware — Work of the Bureau of Mines and State University in Furthering Clay-Working Industries by Scientific Research and Training—Stoneware Plants at Akron and Near Roseville

BY CHESTER H. JONES

WHILE the ceramic industries fall under five general divisions—namely, clay products; cements, limes and plasters; glass; enamels for metals, and abrasives—the purpose of this article is to deal chiefly with descriptions of some Ohio plants which are in the first-mentioned class.

The total value of all ceramic products made in the United States in 1918, according to the Bureau of Mines, amounted to about $447,000,000. Of this sum $222,000,000, or nearly one-half, represented clay products. Of these clay products 76 per cent were embraced by brick, tile and other structural materials and 24 per cent by the finer grade wares classed as pottery. The four leading states in the percentage of the total valuation of each were: Ohio, 23.8 per cent; Pennsylvania, 18.2 per cent; New Jersey, 9.3 per cent, and Illinois, 5.6 per cent. Ohio produced as much as the states of New Jersey and Illinois combined, or an amount nearly equal to one-fourth of the nation's output.

The annual production of the white pottery classed as "tableware" in the United States was $31,600,000, with Ohio's annual production at about $16,500,000, or 52.2 per cent of the output. Summarizing, then, for the state there is produced annually 17.4 per cent of all ceramic products, including clay products; 23.8 per cent of all clay products, including white pottery; and 52.2 per cent of the white pottery, including "tableware."

The state has approximately 550 different clay-working plants with an average production of $96,000 each annually. While nearly every county has one or more plants, the southeastern half is the more prolific territory for the clay-working industry. Because of the concentration and extent of these fields and the nature of the production processes there are more ceramic problems in Ohio needing solution, more opportunity for application of technical control and research in clay products than in any other state.

BUREAU OF MINES STATION

Ohio clay plants are particularly fortunate in having the Columbus Experiment Station of the U. S. Bureau of Mines located at Ohio State University, Columbus. The work at this station is devoted almost entirely to ceramics and because of its location, it is able to be of peculiar service to the district while developing facts for the industry in general. Research is carried out under the direction of R. T. Stull, and embraces the investigation of ceramic raw materials, their mining and utilization in the manufacture of finished products, the investigation of ceramic manufacturing problems with the object of finding ways of eliminating waste, to reduce the cost of production and to improve the quality of the products. Examples of the nature of this work are found in reviewing one or two of these investigations.

RESEARCH ON GRAPHITE CRUCIBLES

Prior to 1914 practically all graphite crucibles manufactured in the United States were made from Ceylon graphite bonded with German Klingenberg clay, and the general belief among manufacturers and users was that good crucibles could not be made from American bond clays and graphite. The station undertook the investigation of American bond clays in order to determine their crucible-making properties, and after much work finally found twenty clays which appeared to be promising, eighteen of which were domestic products. Two of the latter were excellent for brass and eleven for steel melting. Over 40 per cent bond clay was used in the blend. The different phases of the work have been published and the crucible makers have been quick to profit by it. In so far as has been determined, no German Klingenberg clay is used in America at the present time and it is gratifying to note that some crucible makers advertise the superior quality of their crucibles as due to the use of the best American bond clay.

DOLOMITE REFRACTORIES RESEARCH

Large quantities of magnesite refractories are used for furnace linings in the metallurgical industry. Before the war substantially all the magnesite used for the manufacture of refractories came from Austria and Greece. When Austria entered the war the exportation of magnesite was cut off and soon afterward the exportation of the Grecian product stopped. The Columbus Station undertook research and patented processes of preparing dolomite for refractory purposes. It is hoped that firebrick can be made from dolomite that will compare with the magnesite firebrick, thus developing a new industry of far-reaching importance. Ohio, with its thousands of acres of dolomite to furnish the raw material for firebrick and its cast-iron and steel industry to utilize them, will profit more than any other state by this work when it is completed.

Investigations which have been running are still under way at this station and may be summarized as follows:

1. Physical properties of the white clays east of the Mississippi River as compared with the imported clays.
2. Tests on clays for the U. S. Geological Survey.
3. Co-operative investigation of Ohio fireclays.
4. Crucible-making properties of domestic bond clays and graphites as compared with the foreign.
5. Properties of dolomite as a refractory for furnace linings.
6. Brick suitable for malleable iron furnace bungs.
7. Load tests of firebrick at furnace temperatures.

8. Luster compositions for pottery decoration.
9. Physical properties of two California clays.

At the end of this article will be found a list of the publications which have been prepared at the Columbus Ceramic Experiment Station up to the present time.

Ohio State University

The course in ceramics at the Ohio State University, which has the main object of developing ceramic engineers for the industry, was arranged to co-operate with the Bureau of Mines station with a view to increasing efficiency in the utilization of mineral resources necessary to the ceramic industry, stimulating and upbuilding this industry in the United States and substituting ceramic products of American manufacture for those now imported. Aside from the excellent work and service done with the bureau station, this school, under the direction of Prof. Edward Orton and Prof. A. S. Watts, produces engineers who are invaluable to the industry and upon whom depends its development in the highest sense.

In visiting the various plants briefly described in the following paragraphs it was pleasing to find that the executives and technical men therein all turn toward the Bureau of Mines station and the university for inspiration and help.

The U. S. Stoneware Co.

Located in Akron, Ohio, the U. S. Stoneware Co. has been known for more than fifty years as a producer of superior quality common stoneware. Twenty-five years ago it developed a chemical stoneware, which has high heat-resisting qualities as well as acid- and alkali-proof features. This last-mentioned line has been so greatly in demand it is now the major portion of the company's business. The raw clays from which both classes of ware are manufactured come mostly from mines owned by the company and located near the plant. They are properly blended during the refining process to get the required body for the final product. The company claims a superiority of ware due chiefly to the excellent and uniform quality of this clay, which is in thin veins so far below the surface that it must be mined through an entry slope, in much the same manner as coal is taken out.

Chemical Stoneware Process

The raw material is brought from the mines both in automobile trucks and by rail. It is dumped into bins below the grade, whence it is drawn to the wet pans or chasers as the case may be, depending on the type of body desired.

Part of this clay is treated by the wet process and is dumped from the bins to an 8-ft. washer, where water is added during the mixing and grinding operation, the total time consumed per batch being about twenty minutes. From the washer it is transported to a blunger or agitating tank, where it is whipped to a fine creamy consistency in water solution. From the blunging operation this creamy slip is passed through a revolving screen, which removes any large or gritty particles. It passes from the screen to a large cistern, where it is kept in constant agitation until pumped through the plate type filter presses. The cake removed from these presses is the plastic material used in molding certain types of stoneware.

Various bodies and mixtures are required when ware is to be produced for resistance to corrosive liquids, and for some purposes the raw clay is treated in the chaser mill. The time required for each batch is about two hours. It is ground very fine with a minimum amount of water added until a tough plastic material is made.

Shaping

The company advocates the use of standard shapes in laying out chemical plants instead of the employment of special shapes to fit individual layouts. Large numbers of standard pieces are produced to fill orders from stock with greater dispatch. Molding of special shapes of stoneware where plaster of paris molds are employed becomes expensive because of the continual necessity for discarding the mold.

Much of the clay is hand-beaten or "batted out" just before shaping on the jollies, as in the manufacture of chinaware, to get a denser body. Special pipe shapes and fittings are also formed in molds. No chemical stoneware pipe is produced on the sewer pipe steam press, since it is essential that all chance of laminating the clay be avoided. The smaller pieces of stoneware are made on the jolly, a form of horizontal potter's wheel with mold of cup shape so as to give the outside contour desired while the inner surfaces are formed by the hand or tool as the whole turns on the vertical axis. Large pieces such as receivers, tanks, pipe and fittings, Cellarius tourills, tower parts and covers are molded in plaster of paris molds, the clay being worked into shape by hand. Large stoneware jars are thrown in a Week's jar machine. Carboy stoppers are pressed from a dry clay.

Drying, Glazing and Burning

All ware is given careful treatment during drying. The pieces are placed over grated floors beneath which steam pipes are laid. Although the body of the stoneware is acid-proof, additional protection is obtained by completely covering it with a special glazing material before burning. This glaze is made up according to a special secret formula which has been developed after considerable investigation and research. In appearance

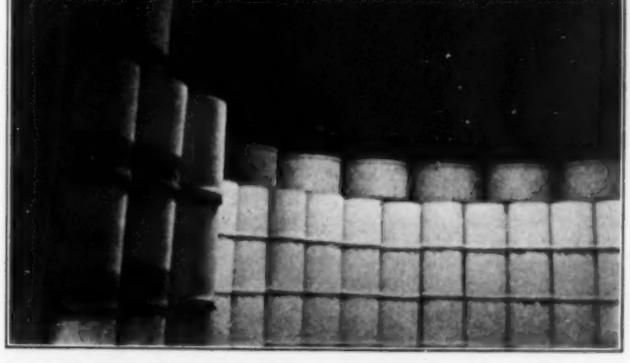


FIG. 1. STONEWARE IN KILN, BEFORE BURNING

it resembles the original acid-proof clay. The various glazes used for chemical and common stoneware employ, as the principal apparatus used in the making, a Patterson pebble mill, where the wet grinding is carried out. For common stoneware, white glazes are made chiefly from kaolin and ball clay; the darker colors are obtained with Albany and Michigan slips. The chemical stoneware glaze gives a yellow color to the finished pieces.

FIG. 2. STONEWARE IN KILN, AFTER BURNING

Another product of this factory is the pot used in the manufacture of white lead by the old Dutch process. The lower portions of these pots where the acetic acid is held are covered with the acid-proof glaze.

The burning equipment consists of seven down-draft periodic kilns of 32 and 34 ft. diameter, which burn coal from the Ohio mines, owned by the company. Figs. 1 and 2 show pieces of common stoneware stacked in kilns before and after burning respectively. In Fig. 1 the bats separating the jars to prevent the glazed pieces from melting together are seen. These bats are simply small burned pieces of clay. The dark glaze on top and the lighter glaze on the bottom of inverted jars are seen in the left of this picture. Fig. 2, giving view of the partly emptied, finished kiln, shows how pieces of equal size are built in tiers up from the floor for equal distribution of draft with the odd shapes piled on the top to get the best heat zone without interfering with the draft. Cones are used in heat control.

Some of the common stoneware pieces are made on the steam sewer pipe press, others on the jar machine and the jugs and odd round pieces are thrown on jollies. A wide variety of chemical and common stoneware products are placed on both markets. Three switches lead trackage into the plant, giving connections for shipment on four different railroads.

Ramsbottom Bros.' Pottery Co.

The Ramsbottom Bros.' Pottery Co., located near Roseville, in the southeastern Ohio district, is one of the largest concerns engaged in the manufacture of common stoneware products. It was organized about ten years ago, the factory being constructed in the district where the necessary raw product was easily available. The native clay is mined in the vicinity of Roseville and Ironspot, being obtained by drifting into the hillside after the manner in which coal is mined. The overburden is so great that it is not possible to strip it off to get at the required seams. Some of these clays are said to be adapted for use in the manufacture of soft gardenware and chemical stoneware, although this company does not produce the latter class of product at the present time.

FIG. 3. TRAM BUCKET HANDLING CLAY FROM PUG MILL

Process of Refining

The clay is delivered on a platform at the plant, coming from the mines in automobile trucks. Three different grades of clay are blended by shoveling from the three piles into a three-way chain conveyor, which feeds each one into a common screw conveyor, where they are automatically mixed while being transferred to the battery of three blungers.

In the blunger the mixture is fed with water and is all whipped up by revolving paddles to a fine creamy consistency and subsequently pumped at 100 lb. pressure to the filter presses. The water from these filter presses is returned to a cistern, where it is kept in constant agitation and again returned to the blungers for further mixture. From the filter presses cakes which have a consistency of putty are fed into the large pug mills.

FIG. 4. JIGGERS

While these mills are working out the air and extruding the finished powdered material at the far end, the clay is tempered with a clay slip in place of the clear water commonly used. This clay slip is the type of material that is taken from the blungers to the filter presses. The consumption of raw clay at this plant is about 80 tons per day.

Common practice in most pottery plants is to transport the tempered clay from the pug mill to the jiggers and molding rooms by wheelbarrow. It is in this feature, as well as in other mechanical equipment, that the company has improved over the practice at other plants. Fig. 3 shows an operator at the delivery table of the pug mill in the act of starting off a bucket of

clay to the modeling room. The entire output of the plant is handled by one man, who throws batches of clay either into the tram buckets or onto a shelf elevator, the latter of which delivers clay to the jar machines on the upper floors.

This aërial tram is fashioned after the manner of a mining type or hay-transporting type of equipment and travels along a cable directly over the row of workmen's benches. When the workman desires an additional supply of clay for his molding or jiggering operations he simply throws in a lever which stops the bucket and automatically dumps it. It is then returned to the pug mill for another load. The clay which is sent up on the shelf elevators to the jar-throwing machine is automatically cut at the pug mill to furnish just the

FIG. 5. FILLING MOLD ON JIGGER

right amount of clay for each jar. These jar machines are essentially steel-cased jiggers operated by an interior rolling device for running the clay up the side of the jigger.

Fig. 4 shows a row of jiggers for casting jugs, butter jars, etc. The clay tram is seen just dumping at one of the benches. Fig. 5 shows an operator placing the clay in the interior of the plaster of paris mold on the potter's wheel before he brings down the jigger lever to the left for forming the true interior of the piece. Common stoneware jugs are made in two pieces, the top being separate from the bottom and the two parts of clay later joined and worked together by the hand. The jug handle is later placed on by hand, the clay being wet down to cause it to form one piece with the side of the jug.

The steel jiggers for producing the big jars are lined with paper to prevent the paper from sticking to the metal. These particular Week's machines have revolutionized the industry so that one man can do the same amount of work in twenty-four hours that was previously done by five. Different steel molds are used for producing sizes from 5 to 50 gal. capacity.

Steam and Power

Power for operating the various machinery around the plant is furnished by a 60-hp. induction motor, which drives the shafting for one section of the plant, and the remainder is driven by a 125-hp. steam engine. The total boiler installation is 300 hp. The steam from these boilers, after passing through the engine, is conducted in the steam piping to the rooms for drying the ware. The coal supply for the boilers is mined from the same locations as the clay properties.

Drying

The drying rooms are located adjacent to the jiggers and molding rooms and consist, on the first floor, of a series of steam pipes overlaid with a wooden grating. Above this grating is located the shelves upon which the ware is placed. The heat from the drying room on the first floor is carried through openings to the second floor, where the larger pieces from the jar machines are placed. This upper compartment consists of a large open room with a low roof. It is in this room that the plaster of paris molds are made for use on the jiggers. Each mold gives about one year of service before it has to be replaced.

Glazing

Two general types of glazes are used for the stoneware, one the dark color and the other the white glazes. Feldspar, zinc, whiting and ball clays are used in the manufacture of these plain glazes, and Albany and Michigan clays are used for colored glazes. The dried ware is glazed on the outside by dipping into a vat and on the inside by inverting a jug over a spigot, for instance, and pushing down a lever which sprays the inside of the piece, entirely covering it with glaze. After this is done the bottoms of the pieces are washed off to prevent them from sticking in the kiln.

Burning

The kiln room equipment consists of thirteen down-draft periodic kilns 30 ft. in diameter. A battery of four kilns is exhausted through a common stack. Natural gas is used for fuel, coming from the Ohio Fuel Supply Co., which taps the West Virginia field. Fig. 6 shows kiln under fire with large stack on the left.

The ware is loaded into the kiln in all sizes, the larger pieces being separated by bats or small pieces of burned

FIG. 6. DOWN-DRAFT PERIODIC KILN UNDER FIRE

clay, to prevent the glazes from sticking during the burning operation. No saggers are employed. The time required for burning is a three-day cycle. Only one burning is required for both body and glaze, the temperature reached varying from cone 8 to cone 9.

The scrap, or refuse, from molten stoneware in this plant is so completely vitrified as to make an excellent material for grog, and is sold by the carload to various

other clay plants. All the broken stoneware is dumped into a bin below the level of the kiln room floor, whence it is carried up by a specially designed Jeffrey chain elevator for dumping into wagon and automobile trucks and conveyances to the dumping platform on the railroad.

PRODUCTS

The chief output of this plant is stoneware jugs, flower pots, jars, cuspidors, frost-proof gardenware, butter jars, home brew jars and other domestic stoneware. It is extremely interesting, in looking over the products in the storage room, to note that an entirely different type of stone jar is manufactured for use in Pennsylvania as compared with those used in the southern section of the United States. The Pennsylvania jar is a rather tall rounding shape, with a comparatively small bottom, so that it may be placed in the running water at the dairy house, while the jar used in the South is provided with a groove below the lip so that a cloth cover may be tied over and secured by a string running around the groove. The entire output is marketed through the American Clay Products Association.

Not unlike many other clay-working plants, the morale of this organization is maintained by direct contact between the workmen and one of the partners, who acts as superintendent of the plant. There was considerable difficulty in this section recently in getting an adequate supply of labor. The workmen were lured away by the high prices paid in the coal mines in the same territory. Since the business depression, however, the workmen are gradually returning to the clay-working industry. Another feature worthy of note is the fact that about 45c. per thousand feet is paid for natural gas used in burning the ware. This charge is increasing every year, and it is only a question of a short time when the company will be forced to convert the kilns so that coal may be used as fuel.

It is predicted that it is only a question of time when the wet process of producing the tempered clay for pottery work will be replaced by the dry process, where the clays are ground to pass a 100-mesh screen and stored away for aging for a period of from thirty days to three months. This aging destroys the effect of lining and breaks up the otherwise hard lumps in the clay, so that eventually more plastic material is produced.

Ceramic Publications of the Bureau of Mines

"The Effect of Electrolytes on Some Properties of Clays," *Journal*, American Ceramic Society, vol. 1, No. 3 (1918).

"The Properties of Some Ohio and Pennsylvania Stoneware Clays," *Journal*, American Ceramic Society, vol. 1. No. 4 (1918).

"A Pycnometer Operated as a Volumeter," *Journal*, American Ceramic Society. vol. 1, No. 8 (1918).

"Fusibility of Graphite Ash and Its Influence Upon the Refractoriness of Bond Clay," *Journal*, American Ceramic Society, vol. 2, No. 1 (1919).

"Behavior Under Brass Foundry Practice of Crucibles Containing Ceylon, Canadian and Alabama Graphites," *Journal*, American Ceramic Society, vol. 2, No. 3 (1919).

"Experiments in Dead Burning Dolomite," *Journal*, American Ceramic Society, vol. 2, No. 4 (1919).

"Effect of Variable Pressure and Tar Content on the Briquetting of Alabama Graphite," *Journal*, American Ceramic Society, vol. 2, No. 5 (1919).

"The Effect of Electrolytes on the Properties of Graphite Crucible Bodies," *Journal*, American Ceramic Society, vol. 2, No. 6 (1919).

"Some Properties of Bond Clays for Graphite Crucibles," *Journal*, American Ceramic Society, vol. 2, No. 6 (1919).

"A Machine for Testing the Hot Crushing Strength of Firebrick," *Journal*, American Ceramic Society, vol. 2, No. 8 (1919).

"The Need of Technical Assistance in the Brick Industry," *Journal*, American Ceramic Society, vol. 3, No. 3 (1920).

"Elutriation Tests on American Kaolins," *Journal*, American Ceramic Society, vol. 3, No. 7 (1920).

"Behavior of Firebrick in Malleable Furnace Bungs," *Journal*, American Ceramic Society, vol. 3, No. 7 (1920).

"The Fusibility of Mixtures of Graphite Ash and Bond Clays," *Journal*, American Ceramic Society, vol. 3, No. 8 (1920).

"A Direct Reading Overflow Volumeter," *Journal*, American Ceramic Society, vol. 3, No. 9 (1920).

"The Position of Clay Products in the Field of Earthen Products," *Brick and Clay Record*, March 6, 1919.

"Government Service in Developing the Clay Industry," *Clay Worker*, March 25, 1920.

"Graphites and Bond Clays for Crucible-Making Purposes," *Mining Congress Journal*, 1920.

"The Properties of Some Stoneware Clays," Bureau of Mines Tech. Paper 233 (1920).

READY OR IN PREPARATION FOR PUBLICATION

"The Effect of Wet Grinding, Screening and Electrolytes on Clays of Low Plasticity," *Journal*, American Ceramic Society.

"Tests on California Refractory Clays," *Journal*, American Ceramic Society.

"Experiments With Aventurine Glazes," *Journal*, American Ceramic Society.

"Some Decorative Lusters for Pottery," Bureau of Mines Technical Paper.

"Behavior of Bond Clays in Crucibles Under Brass- and Steel-Melting Practice," *Journal*, American Ceramic Society.

"The Use of Electrolytes in the Purification and Preparation of Clays," Bureau of Mines Bulletin.

"White Clays East of the Mississippi River," Bureau of Mines Bulletin.

"Preparation of Dolomites for Refractory Purposes," Bureau of Mines Bulletin.

"Crucible-Making Properties of Graphites and Bond Clays," Bureau of Mines Bulletin.

"Aventurine Glazes," Bureau of Mines Technical Paper.

"The Application of a New Principle to Clay Washing,' *Journal*, American Ceramic Society.

Treated Wood Gives Increased Yield of Methanol*

An increase of 50 per cent in the yield of methanol may be obtained by means of an inexpensive treatment consisting of the addition of a small percentage of sodium carbonate to the wood before distillation. Experiments show that this increased yield may be obtained without diminishing the yield of acetic acid. Contact of the carbonate with all of the wood is necessary to obtain the full benefit of the treatment; hence the method is likely to prove the most valuable in connection with the distillation of sawdust or small blocks, because of the difficulty of getting thorough impregnation with larger pieces. Saturation with a solution of the carbonate is a sufficient treatment for the sawdust, but a pressure treatment is necessary to impregnate the wood blocks.

Below are some of the actual results obtained at the laboratory.

SAWDUST UNTREATED AND TREATED WITH SODIUM CARBONATE AND BRIQUETTED

Species	Catalyzer	Yield in Per Cent of Original Weight: Alcohol	Acetic Acid	Remarks
Maple	None	1.61	5.22	Average of 4 runs
Maple	1.5%	2.39	5.26	Average of 3 runs
White oak	None	1.17	4.91	Average of 2 runs
White oak	0.5%	2.58	5.09	

BLOCKS OF WOOD UNTREATED AND TREATED WITH SODIUM CARBONATE

Maple	None	1.67	7.65	
Maple	1.12%	2.16	6.74	Pressure treatment
Oak	None	1.20	5.56	
Oak	1.03%	1.79	5.58	Pressure treatment

Other amounts and other chemicals were tried, but the results given are the most promising of any.

*From U. S. Forest Products Laboratory *Technical Notes*.

Improved Method of Electrolytic Etching for Microstructure

By W. Velguth

ELECTROLYTIC etchings are usually very flat, of one uniform color as shown in Fig. 1, and while this method of etching brings out a good structure, better results can be had by cleaning the specimen to be etched. The true orientation of the grain structure can be brought out more clearly by first cleaning the specimen electrolytically in a caustic solution or in a solution of sodium thiosulphate, and then etching electrolytically in acid.

In determining the microstructure of the nickel alloys used for negative terminal of base metal thermocouples both these electrolytes were used to good advantage, as can be seen from the accompanying micrographs. Using a 10 per cent solution of sodium thiosulphate as the electrolyte, the polished specimen is made the cathode and a carbon rod the anode. On a 10-volt, direct-current circuit, with a current density of 1.55 amp. per sq.in., the specimen is cleaned in five to ten seconds. With a drop of the thiosulphate solution adhering to the polished surface, the sample is transferred to a 10 per cent solution of hydrochloric acid. The sample is now made anode and a carbon rod is the cathode. With a current density of 0.62 amp. per sq.in., most of the microstructure shown in Fig. 2 can be developed in eight to ten seconds. Contact was made with the specimen before it was lowered into the acid. If the sample was washed free of thiosulphate before it was transferred to the acid, results were uncertain.

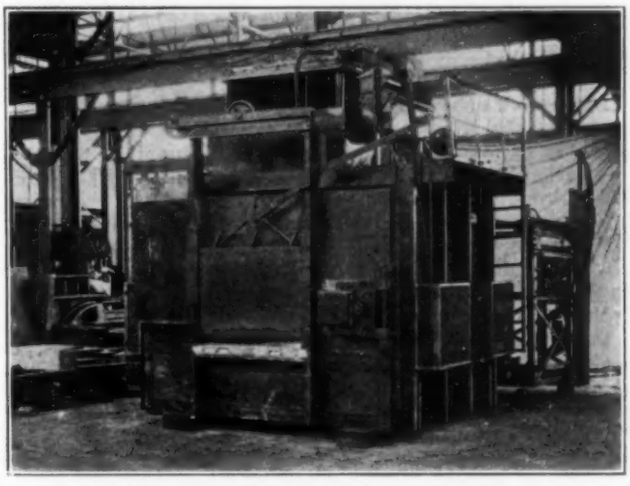
When the etched specimen is removed from the acid, the surface will be a dull gray or blue. Wash it gently in a stream of water; shake off all surplus water, and dry in a blast of warm air. The surface now takes on various shades of color, and is bright and clear. Some of the etchings were shades of blue, purple, green or red, while again in some instances each grain area had a different color. This coloring in no way interferes with the details of the microstructure.

Cleaning the specimens electrolytically in a 10 per cent caustic solution also gave good results when followed by electrolytic acid etching (Fig. 3), but the colors produced were shades of yellow only.

Resistance Type Electric Furnace for Sheet Heating

In the manufacture of automobile body and fender stampings it is of the highest importance that the heating operations be conducted with as little scaling as possible, for any pitting due to this action requires considerable additional labor in getting the defects sand-blasted to sufficient extent to get a good finish on the part.

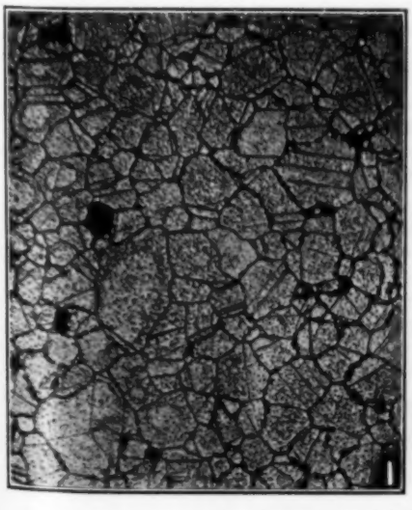
The Mullins Body Corporation, Salem, Ohio, with this in mind recently installed in its new plant a Baily electric furnace specially designed for this work. Since a large part of pressing or drawing to shape done by this concern is performed cold and only one or two hot runs are required for perhaps six or seven cold operations on the press, it was desirable to build a furnace of



ELECTRIC FURNACE FOR SHEET HEATING

the portable type which could be handled by a crane and taken from place to place so that there would be no idle furnaces while the material was receiving its cold runs. This necessitated a furnace with four eye-bar connections at the top, one at each corner, for hooking on the crane chains; and also that the transformer and control equipment be located on the top of the furnace, as is shown in the photograph.

The furnace is rated at 100 kw. in electrical capacity, and has a hearth 3 ft. 4 in. wide x 6 ft. 5 in. long with



FIGS. 1 TO 3. MICROSTRUCTURE OF NEGATIVE THERMOCOUPLE WIRE AS DEVELOPED BY DIFFERENT ELECTROLYTIC METHODS

Fig. 1. Electrolytic etching in acid solution.

Fig. 2. Cleaned in sodium thiosulphate before acid etch.

Fig. 3. Cleaned in caustic solution and etched in acid with current.

a door opening 3 ft. 4 in. wide x 2 ft. 2 in. high. It has a capacity for heating 750 lb. of material to 1,800 deg. F. per hour. In plants where a crane is not available for moving the furnace the equipment is designed for mounting on a car which may be moved at the will of the operator on a track running parallel to the battery of presses.

One of the notable features of this equipment is the remarkable uniformity of temperature obtained on the sheets. Scaling is also reduced to an almost negligible item.

Synopsis of Recent Chemical & Metallurgical Literature

Nitrogen Products.—A statistical supplement to the final report of the Nitrogen Products Committee of the British Ministry of Munitions has recently been compiled by Dr. J. A. Harker, the former director of the Nitrogen Research Laboratory. In addition to bringing all of the statistical information up to date, the supplement presents a concise and interesting review of recent developments in the world's nitrogen industry. The former report had been prepared during the war period and did not cover the latter half of 1919 nor any of 1920.

It is of interest to compare the situation as regards the sources of the world's nitrogen supply before the war and at the present date. In 1912 the output of Chilean nitrate was 2,586,975 metric tons, equivalent to 411,329 tons of nitrogen. This was 57.5 per cent of the total world's production. The byproduct industry produced 1,229,773 tons sulphate of ammonia (containing 24.5 per cent ammonia), or 272,007 tons of nitrogen (38 per cent of total). The fixed nitrogen industry's output was as follows: (*a*) Cyanamide (assumed 18 per cent N) 126,538 tons, nitrogen 22,435 metric tons (3.1 per cent of total); (*b*) nitrate of lime and arc process (assumed 13 per cent N) 75,000 tons, nitrogen 9,907 metric tons (1.4 per cent of total); (*c*) synthetic ammonia, nil; total of fixation industry 201,538 tons, nitrogen 32,342 metric tons (4.5 per cent of total). Grand total, 4,018,286 tons of product, nitrogen 715,678 metric tons.

Comparing with the above the productive capacity existent in the world in 1920, that of the Chilean nitrate industry is given as 2,966,061 tons, the productive capacity of nitrogen being 471,000 metric tons, or 30.2 per cent of the world's total. The byproduct industry, 2,015,440 tons, nitrogen 413,000 metric tons (26.6 per cent of total). The fixation industry: (*a*) Cyanamide 1,777,000 tons, nitrogen 325,000 metric tons (20.9 per cent of total); (*b*) nitrate of lime and arc process 290,400 tons, nitrogen 38,300 metric tons (2.5 per cent of total); (*c*) synthetic ammonia 1,503,000 tons, nitrogen 308,000 metric tons (19.8 per cent); total of fixation industry 3,570,400 tons, nitrogen 671,300 metric tons. Grand total, 8,551,900 tons of product, nitrogen 1,555,300 tons.

Allowance must be made for the fact that the 1912 figures are for actual production, while those of the later year are for productive capacity. It is particularly significant, however, that during this period the world's nitrogen resources have doubled; and that while the percentage of the total contributed by Chilean nitrate *decreased* to one-half, the output of the fixation industry has *increased* almost tenfold, or from 4½ per cent of the whole in 1912 to 43 per cent in 1920. The fixation industry is now the largest single contributor to the nitrogen requirements of the world. It is interesting to note, too, that in spite of the much-talked-of developments in synthetic-ammonia manufacture, the cyanamide installations during the war period have made this process the largest of any of the fixation methods.

Synthetic Acetic Acid.—The manufacture of synthetic acetic acid from calcium carbide is described at length by Maurice Deschiens in a series of three articles published in the March, April and May, 1921, issues of *Chimie et Industrie*. A flow sheet shows the importance of acetylene as a raw product for the manufacture of some of the long series of commercial organic chemicals. The manufacture of calcium carbide, generation of acetylene, hydration of the acetylene to acetaldehyde and the oxidation of acetaldehyde to acetic acid are described.

Manufacture of Calcium Carbide.—After giving the average analysis of the raw materialss (limestone, anthracite, coke) used in Europe, United States and Canada, he describes the operations of the Hafslund furnace (Norway) and of different other furnaces of the single-, two- and three-phase types.

Generation of Acetylene.—He describes in detail the Grivel process used in France and then outlines a series of the processes used in Switzerland, United States, Canada and Germany.

Hydration of Acetylene to Acetaldehyde.—After outlining the preparation of mercuric oxide which is used as catalyzer and describing in detail a process for the preparation of acetaldehyde and rectification to 99.8 per cent purity, he passes in review a long series of other processes used, giving the sources where they are described somewhat more in detail.

Oxidation of the Acetaldehyde.—For the oxidation of the acetaldehyde he follows the same rule as for the hydration of acetylene to acetaldehyde—namely, by first describing in detail a typical process and then outlining a long series of other processes, here also giving the sources where they are described more in detail.

He concludes by giving a brief outline of the potentialities of the synthetic acetic acid industry and by tabulating a long series of articles and patents (German, English, American and French) on synthetic acetic acid.

Wheel Burnt Rails.—C. P. Sandberg read a paper before one of the engineering conferences held by the British Institution of Civil Engineers, June, 1921, entitled "Damage to Tires and Rails by Brakes or Slipping Wheels," in which he described the same phenomena discussed by J. E. Howard[1] in a report to the Interstate Commerce Commission. Sandberg finds a hardened surface, crossed by a multitude of transverse cracks, on tires, brake shoes, tramway and railroad rails, all caused by intense local heating by friction. He agrees with Howard that they are potential causes of failure to railroad rails, which, being supported at intervals, readily allow growth of the damage inward. Tramway rails and wheel tires, however, being solidly supported throughout, are not liable to "detail fracture" from such causes. The author describes the formation of the surface cracks thus: "Sliding of one surface over the other proceeds to a point at which both are hot, soft and plastic, and tend to seize together momentarily at numerous points. While so united the surface layers are dragged bodily forward, forming an overlap in advance of each area of adhesion and a tear behind it. Alternating seize and slip probably occurs many times per second during the application of brakes, producing a series of surface tears or cracks in both brake and wheel, at right angles to the direction of motion."

Latest About the Basset Process.—On the subject of the Basset process the *Iron Trades Review* of Aug. 19, 1921, states that according to the recent annual report of the Ougrée Marihaye Co., which is interested in the Société Française des Aciéries Basset, the process has not yet reached a phase of development which would enable one to arrive at an estimate of the costs of production or to form an opinion as to the value of the process. At the recent general meeting of the Ougrée-Marihaye Co. a shareholder asked the chairman as to the exact meaning of this passage, and whether any new trials have been made since the date of the annual report. He was told that the process was still in its experimental stage, and that since the drafting of the annual report no new experiments have been carried out.

[1] CHEM. & MET. ENG., vol. 24, No. 19, p. 850 (May 11, 1921).

Current Events

in the Chemical and Metallurgical Industries

American Electrochemical Society to Hold Meeting at Lake Placid

The fortieth general meeting, marking the end of the second decade since the organization of the American Electrochemical Society, will take place at the Lake Placid Club, in the Adirondacks, Sept. 29, 30 and Oct. 1.

The technical program will be featured by two symposia, on non-ferrous metallurgy and electrodeposition. The program of the meeting is shown below:

WEDNESDAY, SEPT. 28

6 p.m. Registration at Lakeside Clubhouse.

THURSDAY, SEPT. 29

9 a.m. Presentation and discussion of papers.

Charles Vickers: Experience With Alkaline and Alkaline Earth Metals in Connection With Non-Ferrous Alloys.

W. A. Cowan, L. D. Simpkins and G. O. Hiers: The Electrolytically Produced Calcium-Barium-Lead Alloys Comprising Frary Metal.

Colin G. Fink and Charles H. Eldridge: The Electrolytic Corrosion of Lead-Thallium Alloys.

J. Newton Friend: A New Theory of the Corrosion of Iron.

Haakon Styri: Rust Prevention by Slushing.

C. J. Rodman: Transformer Oil Sludge.

Raymond Freas: The Electrolysis of Organic Compounds.

Alexander Lowy and E. H. Haux: Electrolytic Oxidation of the Leuco-Base of Malachite Green.

N. Kameyama: The Electrolytic Dissociation of Cyanamide and Some of Its Salts in Aqueous Solutions.

P. C. Alsgaard: Electrolytic Production of Sodium Perborate.

H. M. Goodwin and C. E. Walker: Electrolytic Production of Perchlorate.

B. G. Worth: Graphic Control of Electrolytic Processes.

2 p.m. Sports and recreations. Golf match under the direction of Mr. Dorr, chairman of golf committee.

A boat ride has been planned for this afternoon for the benefit of those not participating in golf. There will also be other entertainment under the direction of Mr. Corse, chairman of committee on arrangements. Additional information available at the registrar's desk.

6:30 p.m. Board of directors' meeting, at dinner, for the transaction of usual business.

8 p.m. Meeting in the music room of the Forest Clubhouse.

Lecture by Prof. Harlow Shapley, of the Harvard University Observatory, on "Chemistry and the Stars."

FRIDAY, SEPT. 30

9 a.m. Reading and discussion of papers.

Symposium on Non-Ferrous Metallurgy

H. M. St. John: The Influence of the Electric Furnace on the Metallurgy of Non-Ferrous Metals.

E. A. Smith: Modern Developments in the British Brass Industry.

T. F. Baily: Resistance Type of Electric Furnace in the Melting of Brass and Other Non-Ferrous Metals.

N. K. B. Patch: Comparison of Electric Furnace Practice With That of Fuel-Fired Furnace Practice.

H. A. DeFries: Electric Silver Melting.

F. C. Thompson: Electric Furnace Melting of Nickel-Silver.

H. A. Winne: Recent Developments in Electric Furnaces of the Muffled Arc Type.

J. G. Thompson: Electric-Furnace Purification of Zirkite.

M. L. Hartmann and W. A. Koehler: Physical Characteristics of Specialized Refractories. Part IV.—Cross Breaking Strength at 20 Deg. and 1,350 Deg. C.

2 p.m. Sports and recreations. Continuation of golf match of previous afternoon.

Mountain hiking and other sports, under direction of Mr. Hinckley, chairman of other outdoor sports committee.

Indoor sports will be taken care of by Mr. Crosby, chairman of that committee.

8 p.m. Lecture by Colonel T. S. Woolsey, Jr., on "Practice of Forestry on National Forests"; to be held in the music room of the Forest Clubhouse.

SATURDAY, OCT. 1

9 a.m. Reading and discussion of papers.

Symposium on Electrodeposition

F. A. Lidbury and F. A. Stamps: An Electric Steam-Generator for Low Voltage.

W. E. Hughes: Researches on the Electrodeposition of Iron.

T. R. Briggs: Electrolytic Solution and Deposition of Copper.

W. R. Ingalls: Electrometallurgy of Zinc.

C. J. Wernlund: Deposition of Zinc From the Zinc Cyanide Solution.

William Blum and H. E. Haring: The Electrodeposition of Lead-Tin Alloys.

William Blum: The Structure and Properties of Alternately Electrodeposited Metals.

2 p.m. Golf finals for the society championship, those having qualified in the matches of the two previous days will participate.

Motor bus ride to the Club Farms.

Claim Large Saving for New Phosphoric Acid Process

The Department of Agriculture is sending to all newspapers in the country the following statement with regard to its work on phosphoric acid recovery:

> The United States owns the richest and most extensive phosphate fields in the world. Heretofore heavy annual wastes of valuable phosphatic material have occurred during the mining and manufacturing processes. A new method of controlling these losses devised by the United States Department of Agriculture consists in mixing the "run-of-mine" phosphate with sand and coke and smelting the mass in an electric or fuel-fed furnace. In this process the phosphoric acid is driven off as a fume and may be readily collected in concentrated form. Millions of tons of phosphates previously wasted will be saved potentially as a result of the perfection of this new reclamation system.

Society of Textile Chemists Proposed

The organization of a society of textile chemists was considered at a meeting held in the Chemists' Club Sept. 13. A number of representatives of this branch of the chemical industry attended and Prof. L. A. Olney of the Lowell Textile School was elected chairman. From the expressions of opinion there seemed to be little doubt that an organization of this character was a very feasible proposition. Accordingly a representative committee was appointed to study the possibilities in this direction.

List of Research Chemicals in Preparation

In our issue of July 6, p. 35, attention was called to a forthcoming publication of the National Research Council in which research chemicals and others not commonly available will be listed. Dr. C. J. West now requests that all those desiring a copy of this publication notify him at the National Research Council, 1701 Massachusetts Ave., Washington, D. C.

Gypsum Industries' Association Cited for Unfair Competition

The Gypsum Industries' Association, Chicago, Ill., its officers and members have been cited in complaint of unfair competition by the Federal Trade Commission. Thirty days are allowed to file answers to the complaints, which are issued after preliminary inquiry by the commission upon petition filed with it. After answer the cases come on for formal trial on the merits, full opportunity being afforded the companies to refute the allegations of the complaints, to present their witnesses, introduce evidence, etc. Those cited are:

(1) Gypsum Industries' Association, Chicago, Ill., a voluntary unincorporated association, composed of persons, partnerships, and corporations engaged in many of the states in manufacturing and selling gypsum products.

(2) The executive officers and members of standing committees: Ray C. Haynes, president and member of the executive committee, which committee is ex officio the board of directors of said association; James Leenhouts, vice-president and member of the executive and trade relations committee; R. G. Bear, treasurer and member of the executive and trade relations committee; H. H. McDonald, secretary; M. A. Reeb, member of the executive and trade relations committee; A. R. Black, L. E. Armstrong, A. A. Wolf, J. C. Seguine and W. E. Shearer, members of the executive committee; H. W. Blacksom, Warren Hanley, E. G. West, H. C. Hamilton and F. G. Ebsary, members of the trade relations committee.

(3) Members of the Gypsum Industries' Association as follows: Acme Cement Plaster Co., St. Louis, Mo.; American Cement Plaster Co., Chicago, Ill.; American Gypsum Co., Fort Clinton, Ohio; Cardiff Gypsum Plaster Co., Fort Dodge, Iowa; Centerville Gypsum Co., Centerville, Iowa; Colorado Portland Cement Co., Denver, Col.; Connecticut Adamant Plaster Co., New Haven, Conn.; Dakota Plaster Co., Rapid City, S. D.; Ebsary Gypsum Co., Rochester, N. Y.; Empire Gypsum Co., Rochester, N. Y.; Grand Rapids Plaster Co., Grand Rapids, Mich.; Higginson Manufacturing Co., Newburgh, N. Y.; Kelley Plaster Co., Sandusky, Ohio; J. B. King & Co., New York; Alabastine Co., Grand Rapids, Mich.; Nephi Plaster & Manufacturing Co., Salt Lake City, Utah; Niagara Gypsum Co., Buffalo, N. Y.; Overland Cement Plaster Co., Laramie, Wyo.; Pacific Coast Gypsum Co., Tacoma, Wash.; Plymouth Gypsum Co., Fort Dodge, Iowa; Rock Plaster Manufacturing Co., New York; Southern Gypsum Co., Inc., North Holston, Va.; United States Gypsum Co., Chicago, Ill.; Wasem Plaster Co., Fort Dodge, Iowa.

The basis of the complaint, briefly stated, is the alleged concerted activities of the association members to eliminate mail order competition by restricting sales to dealers maintaining retail establishments, and by a division of territory among members so as to limit each member's sales to the territory reached by delivery trucks of retailers to whom he sells.

Want Alcohol Tax to Stay

The removal of the tax on alcohol would flood the country with fly-by-night concerns making carloads of alcoholic medicinals to sell for beverage purposes, it is contended by the American Drug Manufacturers' Association. The pharmaceutical manufacturers are taking active steps to block the campaign now being launched looking to the removal of the tax on alcohol. They declare that thousands of irresponsible men are being kept out of the manufacture of alcoholic medicinals because of the existence of this tax. A statement issued from the Washington headquarters of the American Drug Manufacturers' Association reads in part as follows:

> It is supposed that the removal of the tax would result in a lowering of the cost of medicines, but when you think of the comparatively small amount of a given medicine that goes into a prescription you will realize that the ultimate consumer would not appreciably benefit.
>
> On the other hand, the removal of the tax would simply add to the present depression. The pharmaceutical manufacturer has paid the equivalent of the tax not only on the alcohol now in his warehouse but likewise on the alcohol in the preparations in process of manufacture, in the finished stocks on his shelves and in his unsold product in the hands of the wholesale druggist and corner drug store. The moment the tax is removed the market value of these products, as well as alcohol, will shrink, and since the wholesaler and retailer would look to the manufacturer for credit on the shrinkage of the stocks in their hands, the manufacturer would be called upon to bear this enormous loss alone, a situation that would probably drive some of them to the wall.
>
> It should be borne in mind, too, that the Government would be deprived of revenue at a time when it is called upon to make other important reductions.
>
> From the Government's standpoint there is likewise the objection that the removal of the tax might prejudice the validity of several features of the Volstead act which do not rest upon the Eighteenth Amendment. The Eighteenth Amendment deals only with the use of intoxicating liquors for beverage purposes and the constitutionality of provisions of the Volstead act regulating the manufacture and sale of liquor for other purposes rests upon the power given Congress in the Constitution to raise revenue.

Tenth Annual Congress of the National Safety Council

The tenth annual congress of the National Safety Council will be held in the State House, Boston, Mass., Sept. 26 to 30, 1921. The following is the summarized program:

MONDAY, SEPT. 26

Forenoon: Annual meeting of members, address by Gov. Channing H. Cox, president's address, reports of officers and committees, election of directors.

Afternoon: General session on public safety and education. First aid demonstrations and motion pictures of first aid contests will be shown.

The reception and dance will be given in the evening at the Copley-Plaza Hotel.

TUESDAY, SEPT. 27

General round table and meetings of the following sections: Automotive, Chemical, Construction, Education, Electric Railway, Engineering, Metals, Mining, Packers and Tanners, Paper and Pulp, Public Utilities, Rubber, Steam Railroad, Textile and Woodworking.

There will also be a meeting of the A B C section and of the local council officers. A series of motion pictures on safety will be shown late in the afternoon.

WEDNESDAY, SEPT. 28

Meetings of the following sections: Automotive, Chemical, Construction, Electric Railway, Metals, Mining, Packers and Tanners, Paper and Pulp, Public Safety, Public Utilities, Rubber, Steam Railroad, Textile, Women in Industry and Woodworking.

There will also be a general session under the auspices of the Engineering Section, on engineering and safety, and the second session of the local council officers.

THURSDAY, SEPT. 29

Meetings of the following sections: Health Service, Mining, Public Safety, Steam Railroad.

There will also be a joint meeting of manufacturing sections and a general session on health and sanitation.

In the evening a shore dinner will be given to the delegates.

FRIDAY, SEPT. 30

Meeting of the following sections: Automotive, Health Service, Mining, Packers and Tanners, Public Safety, Rubber, Steam Railroad and Woodworking.

There will also be a women's mass meeting on the subject of safety of the child and a New England conference on motor traffic problems.

Domestic Potash Industry Marking Time

With the exception of two cement mills and two alcohol plants, no enterprise in the United States is producing potash at this time. The domestic industry is marking time awaiting the final action of Congress on the diminishing temporary tariff described in the tariff bill which has passed the House of Representatives. The plants that are idle represent an investment of more than $30,000,000.

Coking Studies at Ohio State University

The department of metallurgy of the Ohio State University, under the auspices of and with the funds provided by the Engineering Experiment Station of the university, has installed a full scale 1-ton vertical coal retort, a complete byproduct recovery system equipped with gas meters, pyrometers and recording calorimeters. With this equipment the entire coal resources of Ohio are being surveyed with the view of obtaining accurate information concerning the possibilities of utilization of Ohio coals for gas making, byproduct recovery and coke production. Five-ton samples of each coal to be tested are obtained, duplicate 1-ton samples of this are carbonized under ordinary vertical retort conditions, the tar, ammonia and light oil recovered and analyzed, and the coke made is obtained and its quality determined by chemical analyses and physical tests. The gas made is measured in a recording and integrating Bailey gas meter and its heat value recorded in a continuous recording Smith gas calorimeter. Also a sufficient amount of each coal is crushed, sized, the coarser sizes jigged and the finer sizes tabled on a Wilfley table. The clean coal is then dried and retorted. In this way it is expected that the most complete information possible will be obtained on all of the Ohio coals. Tests will also be made on mixtures of Ohio coals with coals from other states. It is hoped to get all this information so that the cities of the state can make the most intelligent selection of coals for the production of artificial gas to supplement the waning natural gas supply.

Interest in Tariff Unprecedented

Greater interest is being manifested in the Fordney tariff bill than in any other tariff measure ever presented to Congress. An indication of this is the unprecedentedly large number of briefs which have been filed with the Committee on Finance of the Senate. A large force is required to digest and classify the vast amount of material being sent to the committee.

The unusual amount of interest in this tariff bill is accounted for primarily by the fact that American industry has expanded and is much more extensive than it was in 1909, when the Payne-Aldrich bill was under consideration, or in 1913, when the Underwood bill was passing through its various legislative stages. There are additional reasons, however, for the interest that has been aroused by the Fordney bill. The demoralized commercial situation of Europe has given rise to many uncertainties which have stimulated interest in tariff matters. The whole subject of foreign trade has been receiving unusual attention. Interest has been intensified by the consideration of new policies, such as American valuation and the dye embargo. Considering that valuations are to be on an American basis, many of the rates in the Fordney bill are regarded as being very high. This has resulted in the most determined opposition on the part of the interests which would be affected.

Consumers of kaolin have submitted a brief which attempts to establish that the present duty of $1.25 per ton on English china clay should not be increased. If this duty is advanced to $2.50, as prescribed in the Fordney bill, it will have the most adverse effect on the paper, pottery and other industries, it is declared.

A very determined effort is being made on the one hand to make graphite dutiable at rates much higher than the rate approved by the House, which is 10 per cent ad valorem. The steel industry and other consumers of graphite, on the other hand, want it to remain on the free list. The domestic producers of graphite propose that ore under 50 per cent graphite content pay duty at the rate of 1c. per lb.; ore over 50 per cent graphite content, 2c. per lb.; lump and chip, 3c. per lb.; flake, graphite content, 6c. per lb.; manufactured graphite products, graphite content, 5c. per lb. and 20 per cent ad valorem.

One of the most carefully prepared briefs which has been submitted to the Finance Committee is that of Roy N. Bishop, for the Western Magnesite Association and for the Northwest Magnesite Co. It is contended that a duty of ½c. per lb. on the ore, ¾c. per lb. on calcined magnesite and ¾c. per lb. on magnesite brick are necessary to protect the industry. In the Fordney bill, calcined, dead-burned and grain magnesite are given a duty of ¾c. per lb., while crude or ground magnesite is given a rate of ½c. per lb. Even with the duties requested, the American producers contend that the Austrian mines will furnish fully 50 per cent of American requirements.

On antimony, the Fordney bill prescribes a duty of 1½c. per lb. on regulus, or the metal. The domestic producers of antimony ask 10c. per lb. upon antimony salts, 10c. per lb. on regulus, metal or matte and 8c. per lb. on the antimony content of ores.

On arsenic, the Fordney bill provides 25 per cent ad valorem on arsenic acid, arsenious acid or white arsenic. The industry asks for a duty of 5c. per lb. on white arsenic.

On barytes, the Fordney bill carries a duty of $4 per ton on the crude ore, $7.50 a ton on ground or manufactured barytes and 1c. per lb. on precipitated barium sulphate. The domestic industry asks ¾c. per lb. on crude barytes, 1¼c. per lb. on ground barytes, 1½c. per lb. on barium sulphide, 2c. per lb. on barium carbonate, 2c. per lb. on barium dioxide, 2c. per lb. on barium sulphate, 2½c. per lb. on barium chloride, 2½c. per lb. on barium lithopone, 5c. per lb. on barium nitrate, 8c. per lb. on barium peroxide and 25 per cent ad valorem on all other barium compounds.

Bismuth is on the free list in the Fordney bill. The domestic industry is requesting a duty of 25c. per lb. The same is true of cadmium.

Feldspar is made dutiable at $1 per ton in the Fordney bill. The duty asked is $2 per ton on crude and $6 per ton on the ground or manufactured product.

Fluorspar, in the Fordney bill, takes a duty of $5 per ton for the first year after the passage of the bill, after which it is to be dutiable at $4 per ton. The domestic industry asks that the rate of duty be $6 per ton on material running 80 per cent CaF_2 or better.

Among the other items that are being hard fought is gypsum. The Fordney bill provides a duty of 25c. per ton on the crude material, $1.40 per ton on ground or calcined gypsum, 8c. per 100 lb. on white portland cement and from $3.50 to $14 per ton on Keene's cement.

Farmers to Demand Free Fertilizers

Headed by the Farm Bureau Federation, all the agricultural organizations maintaining headquarters in Washington are uniting in a drive on proposed duties on fertilizer materials. Potash and sulphate of ammonia are made dutiable in the bill that passed the House. Pyrites is on the free list of the Fordney bill, but an effort is being made to have the Senate committee amend the bill so as to provide a duty of $4 a ton on this material.

The agricultural organizations are preparing their case with great care. A report and recommendations in the matter will be prepared by the Finance Committee and also will be placed in the hands of the agricultural bloc in both the Senate and in the House.

Oil Claims Staked During Winter at Fort Norman

When the first steamboat arrived at Fort Norman it was found that about 700 miles of territory along the Mackenzie River had been staked during the winter months. It appears that half-breeds have been spending the winter staking ground, which they were anxious to transfer to the first comers at a small consideration. Much of this ground is said to have been staked inaccurately, and it is feared there will be found to be considerable overlapping and general confusion that will lead to considerable litigation.

To Develop Sulphur Deposits

The Texas Co., Houston, Tex., is developing plans for the utilization of its sulphur properties in Mexico, totaling about 28,000 acres of land. The property is rich in deposits of this material and it is said that preliminary surveys indicate that it can be mined at a cost closely approximating $3 a ton, as compared with a present market price of from $14 a ton and upward for crude material, according to location. It is said that a subsidiary company will be organized to carry out the proposed development.

Stock Promotion and Potash in West Texas

To protect the public from misrepresentation and fraud by unscrupulous promoters and sellers of stocks based on potash deposits in western Texas the United States Geological Survey states that the potash deposits there, instead of being 1,100 or even 300 ft. thick, as represented by the promoters, have not yet been proved to be of workable thickness or of commercial value. Rich potash salts, comprising the mineral polyhalite, which were deposited in association with great thicknesses of rock salt and gypsum in "red beds," as in Germany and in fact at the same time as the German deposits, have been discovered by representatives of the Geological Survey and the Texas University Bureau of Geology and Technology in a co-operative search, but though this discovery, which was made public early in June, is encouraging and interesting, the practical question whether the deposits are thick enough to mine—that is, whether they are worth anything—is yet to be answered.

The results of the tests of the borings from three wells, of which those that are farthest apart are distant from each other about 125 miles, are certainly encouraging, but the Government geologists warn the public that the conditions of drilling and sampling at all three points are so unsatisfactory that it still remains to be seen whether the beds that are rich in potash are thick enough to justify their commercial exploitation. Considerable drilling, including wells in new areas, as well as careful examination, will evidently be necessary to determine the thickness of the potash deposits in any of the areas with the accuracy necessary for sound commercial computations. The potash content of the salts must of course also be taken into consideration. Some other area in the "red beds" region not yet drilled or not properly tested if drilled is likely to contain the maximum thickness of potash deposits. Drill cores are needed instead of the unsatisfactory samples brought up by the bailer, or, worse yet, washed up by the rotary rig without means of accurate determination of the actual thickness of the layer of potash or of its exact depth. Thorough tests with the core drill are justified by the tremendous importance to the whole United States of the discovery of commercial deposits of potash in this region—a discovery of far greater value than that of an oil pool.

T.A.P.P.I. Meeting Postponed

At a meeting of the executive committee of the Technical Association of the Pulp and Paper Industry held Sept. 15, it was decided to cancel the proposed fall meeting at Washington and other points, Oct. 18 to 21. Owing to conditions in the paper industry, it was considered advisable to postpone this joint meeting of T.A.P.P.I. and the American Pulp and Paper Mill Superintendents' Association until some time in 1922.

Secretary's Office Now With A.P.P.A.

The office of the secretary has been removed from 542 Fifth Ave. to the general offices of the American Paper and Pulp Association, 18 East 41st Street, New York, where quarters have been provided on the sixth floor by Executive Secretary Baker.

Japanese to Manufacture Synthetic Ammonia Under Claude Process

A Japanese company has just taken up an option for the manufacture of synthetic ammonia under the Claude process, according to a cable dispatch from Lyons, France. Under the terms of the option the Nipponese firm will pay 7,000,000 f. to the Société de L'Air Liquide.

An English group is also negotiating with the French society for the purchase of a license, for which not less than 10,000,000 f. will be paid.

Britain Removes Embargo on Export of Sulphate of Ammonia

The Board of Trade has lifted the embargo on the export from England of sulphate of ammonia, according to a cable dispatch from London.

Book Reviews

THE JOURNAL OF THE INSTITUTE OF METALS, Vol. XXV. Cloth, pp. xiv+522, with 27 plates, 8vo. Edited by *G. Shaw Scott*, M.Sc. 1921. London: Institute of Metals, 36 Victoria St., S.W.1. Price 31s. 6d. net.

This book contains papers and discussions presented before the annual meeting held in London during March, 1921 (publication committees of American Engineering Societies please notice the date), and, in addition, 120 pages of closely set type containing abstracts of current literature relating to non-ferrous metals and industry. The latter section has become especially important and must represent a great deal of painstaking labor on the part of the half dozen metallurgists who are responsible for the work. No less than 150 publications are regularly examined, from which about 300 articles have been abstracted. Members of the Institute have the privilege of obtaining separate reprints of all these abstracts, printed on one side of the paper only and suitable for separate filing, for a small sum of money.

A paper by Moore, Beckinsale and Mallinson on "Season Cracking of Brass and Other Copper Alloys," together with a voluminous discussion, occupies 115 pages in the book. This paper was abstracted at length in Chemical & Metallurgical Engineering, June 1, 1921 (vol. 24, p. 976). A contribution by P. H. Brace, "Some Notes on Calcium," was also reprinted July 20, 1921 (vol. 25, p. 105).

Another paper which created a great deal of discussion was by Prof. Carpenter and Miss Elam, continuing their observations on recrystallization and grain growth. John L. Haughton, of the National Physical Laboratory, also completed the presentation of his very painstaking and accurate work on the copper-tin equilibrium diagram.

E. E. Thum.

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THE WORLD'S CHEMICAL INDUSTRY AND TRADE, 1913-14 TO 1919-20. By *Dr. W. A. Dyes.* Vol. I, Edition E. xx+752 pp. 1921. Hopf'sche Verlagsbuchdruckerei, Gebr. Jenne, Wittenberg, near Halle, Germany. Price, $5.

Dr. Dyes has felt the need for a yearly international handbook in which to place before the readers abstracts of the literature published in leading periodicals and trade papers of the world on subjects dealing with the economic phases of the chemical industries. With this in view he has compiled the first volume of such a work in which the period from 1913 to September, 1920, has been covered. The abstracts are, more correctly speaking, extracts, since they are paragraphs lifted bodily from the original articles; the book is thus a compilation of clippings from literature published mainly in German and English. Articles published in other languages are condensed, as a rule, into a few lines of German.

An English index of subject matter, an arrangement of main text in German, English and French, a list of some individuals and firms, and finally an index by countries occupy pp. vii to xx. The main text, pp. 1-669, is arranged in alphabetical order with subject headings in German, English and French. Pages 670 to 752 contain an alphabetical list of 461 German companies (Aktiengesellschaften), 1,548 German corporations (G.m.b.H.), 773 British and 561 French companies.

The compilation shows that the selection of the material has been both careful and comprehensive. With the exceptions of the references taken from English literature, however, the handbook will not be of much tangible use to those readers who are not familiar with the German language.

After a general survey of the great mass of subject matter covered it is evident that Dr. Dyes has succeeded in compiling a book which will prove useful to those who wish to obtain information on the economic status of chemical products or on what he calls the "new science of chemeconomy."

Personal

Lieutenant H. B. BRAMLET, Chemical Warfare officer at Camp Meade, has been transferred to Edgewood Arsenal.

Dr. J. B. BROWN is to do research, with Prof. Richards, in the pharmacology department of the University of Pennsylvania.

Dr. A. W. DAVISON has been appointed professor of chemistry at the Rensselaer Polytechnic Institute, succeeding Prof. A. T. Lincoln, who has resigned to join the faculty of Carlton University, Minnesota. Captain Davison was professor of physical and electrochemistry at the University of Cincinnati previous to the war; he entered the Chemical Warfare Service and was in charge of the 50-ton mustard gas plant at Buffalo. For the last two years he has been directing research work for the Virginia Haloid Co.

Dr. C. G. DERICK has severed his connection as chief of research of the National Aniline & Chemical Co. and has organized the company of C. G. Derick & Co., Buffalo, N. Y., and will engage in consulting work and special research.

CARL F. DIETZ, vice-president and sales manager of the Norton Co., Worcester, Mass., has resigned to become president and general manager of the Bridgeport Brass Co., Bridgeport, Conn., which position he assumes Oct. 1.

Major G. M. HALLORAN has been transferred from the infantry to the Chemical Warfare Service. Major Halloran was an instructor in the infantry service school at Camp Benning. He will be assigned to similar duties with the Chemical Warfare Service.

Dr. HARRY F. LEWIS, formerly of the research laboratory of the National Aniline & Chemical Co.'s Buffalo works, recently resigned and is now assistant professor in charge of physical chemistry at Cornell College, Iowa.

Dr. ERNEST E. LYDER, who received his Ph.D. degree at Columbia University last June, has joined the Catlin Shale Oil Co. of Elko, Nev., as refinery engineer. Dr. Lyder was formerly with the H. L. Doherty company.

Major W. N. PORTER has been transferred from the Coast Artillery to the Chemical Warfare Service. He will serve in the administration section.

Major A. L. ROCKWOOD has taken up duties in the supply division of the Chemical Warfare Service.

J. J. WARD has been appointed manager of Carrolton, Mich., plant of the Michigan Sugar Co., succeeding Frank D. Ewen, resigned. Mr. Ward has been connected with the Caro, Mich., works of the company for some time past.

DAVID WHITE, chief geologist of the U. S. Geological Survey, left Washington on Sept. 4, for an extended field trip, during which he will examine reported oil-shale deposits in the northern Appalachian region and will make several stratagraphic studies in the Pennsylvania system.

Obituary

LLOYD W. CHAPMAN, formerly Western editor of CHEMICAL & METALLURGICAL ENGINEERING, died very suddenly of spinal meningitis at his home in Berkeley, Cal., Sept. 6, 1921. He leaves a widow and two children. Mr. Chapman was born in Pepperell, Mass., thirty-four years ago, and was graduated from Amherst Agricultural College. He specialized in chemistry, and this, with a desire to grow up in the West, led him to accept a position as chemist in the laboratory of the Boston & Montana smelter at Great Falls, Mont.—now one of the plants belonging to the Anaconda company. His rise was steady, and when the war broke out he was acting as technical assistant to the superintendent of the large electrolytic copper refinery at that place. He then entered the employ of the du Pont company, and was assigned to work on the extensions to the smokeless powder plant at Penns Grove, N. J. On completion of construction, he was made superintendent of the alcohol and ether department, a position he filled with signal success. When operations were curtailed after the armistice, Mr. Chapman was transferred to the research department and was given several problems in solvent recovery. The solution of one of these involved the design and construction of an entirely new machine for the manufacture of imitation leather, a machine which was installed at the Newburgh plant and surpassed expectations. A desire to enlarge his outlook and to get back in the West led him about two years ago to accept the position of Western editor of CHEMICAL & METALLURGICAL ENGINEERING, to be stationed in San Francisco, and about ten months ago he was transferred to the *Journal of Electricity and Western Industry*, a McGraw-Hill publication, published in that city. Mr. Chapman's business acquaintances will regret the passing of a man of particularly sound technical ability, and his many personal friends will mourn the death of a true gentleman.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, Sept. 19, 1921.

Business in heavy chemicals has shown a steady expansion during the past week, although activity in general is somewhat irregular. Buyers are becoming more confident of the firmness of price levels and are gradually increasing their stocks as consuming demand for their products increases. Buying is still of a conservative character, but individual transactions are gradually increasing and if the stability of prices is maintained, large operation should take place in the near future. Conditions that have persistently hampered trading during recent months seem to be showing signs of clearing up. Increased inquiries from home and foreign buyers are convincing that the last quarter of the year will make the most satisfactory showing. Mexico, South America, Japan and northern Europe are buying chemicals. German prices are firmer in spite of the recent slump in exchange rates, and it is expected that the recovery from this slump will force German exporters into a much firmer position, which will be reflected in prices here. English exchange is somewhat weaker, but prices named for English chemicals for import have not fallen; on the contrary, they are showing signs of greater firmness.

Among the week's developments was a stronger tone to the prussiate of soda market and an advance in prices at the close. Caustic potash also showed a tendency to work upward. Caustic soda continued firm without revealing much price change. Soda ash was somewhat weaker, with imported material a disturbing influence. Bleaching powder was in good request and higher on spot. In general, it may be stated that with the bottom practically struck in every important industry, the greatest era of expansion is plainly seen ahead by some of our leading captains of industry.

CHEMICALS

Imported 88-92 per cent *caustic potash* on spot has shown a stronger tendency during the week and offerings were not as free as noted a month ago. Continued heavy buying, principally by soapmakers, has absorbed a large portion of the available foreign material. Reports were also current that production abroad has been restricted on account of the low prevailing prices. At the close 4¼c. per lb. was considered an inside price for goods ex-store, with sellers generally quoting 4⅛@4⅞c. September shipment was quoted at 4¼c. per lb., c.i.f. New York. Sales of imported *chlorate of potash* were reported during the week at 7¼c. per lb. Shipments of foreign material were offered at 5¾@6c. per lb., duty paid. Domestic producers reported no change in their prices from the 12c. level, f.o.b. works. *Yellow prussiate of potash* sold in a small way on spot at 20c. per lb. Sellers quoted the market at 20@21c. per lb. The red variety has not shown much activity during the past few days and the market is more or less nominal at

28c. per lb. Odd lot sales of *bichromate of soda* were recorded during the week at 7¾@8c. per lb. The movement has been chiefly in small lots and the general quotation is 7¾c. Supplies do not seem to be large, but the conservative character of buying at present is not sufficient to lift the market above its present level. *Solid caustic soda* is quoted at $3.90@$4 per 100 lb., although large sellers assert that the market is drifting nearer to the 4c. per lb. level. Small-lot sales have taken place at 4c. both for domestic and export use. Moderate inquiries continue to reach the market for export shipment. Producers' prices are repeated at 3¼c. per lb., basis 60 per cent, f.o.b. works..

Importers of *barium nitrate* are weaker on this item and quote 7¾@10c. per lb., according to quantity. Prices of imported *barium chloride* tend weaker, although still quoted at former levels of $45@$46 per ton. Arrivals are quoted below these figures. Other barium salts share in the weakness. Continued inactivity has forced further weakness in *white arsenic* prices, which are quoted at 6@6¼c. per lb. *Red arsenic* is held firmly at 11@12c. per lb. The demand for *alums* has been fairly well sustained and prices are quite firm at recent quotations. *Lump ammonia alum* is quoted at 3¼@3¾c. per lb. and *lump potash* at 3¾@4¼c. Continued inquiry for *prussiate of soda* on the spot market and the relatively low supplies have been factors instrumental in bringing about a higher market for this chemical. Sales were reported late in the week up to 12¼c. per lb., ex-store. At the close most dealers refused to shade 12¾c. Foreign shipments were quoted at 11¾c. per lb., c.i.f. New York. Prices on *formaldehyde* during the week have covered a range extending from 12@12¼c. per lb. in barrels. Producers were able to place some business at the inside figure, f.o.b. works. The demand has shown a little more activity than noted a week ago. Spot *oxalic acid* is quoted at 16@17c. per lb., depending upon the brand and quantity. Irregular prices on *tartaric acid* are heard in the open market for imported material and the range extends from 25@26c. per lb. for crystals. The powdered variety is moving at 27@28c. per lb. Domestic material is being held at 35c. per lb., with small-lot trading through the regular consuming channels featuring. Buyers are not showing any unusual interest at present and the movement is mostly of a routine jobbing nature.

Business in *copper sulphate* is fair for this season of the year. August trade did not average up to a year ago. Inquiries are reaching the market for September shipment and it looks as though this month will prove satisfactory from a trade standpoint. There is a fair general demand from the textile, railroad and other consuming industries. Occasional sales go through for export to South America, but the abnormally low prices named for goods by foreign sellers is preventing European business. It is admitted that quite a bit of business for Italy and France could be placed if the price were low enough. Quotations are generally 5¼c. per lb. or higher, but imported sulphate is offered in limited amounts as low as 5c. per lb. Lower prices are named in most quarters on *soda ash*, as the demand has been satisfied by imported material. Spot resale prices are lower at $2 per 100 lb. Prices on imported *permanganate of potash* are lower at 22@24c. per lb., according to seller and quantity.

Coal-Tar Products

Increased activity is noted in all branches of the coal-tar products market. Business during the past ten days has been picking up rapidly and buyers are entering the market more freely than at any time this year. The attitude of Congress seems to have had a great deal to do with the change, as the trade in general is coming to believe more firmly that the Fordney tariff bill will include protection of adequate nature when it is ultimately passed. The market is rapidly being relieved of the great resale surplus stocks that were available. Renewed activity in the textile industry is resulting in a better inquiry for dyestuffs and while large contract business has not developed as yet, there is a broader inquiry for small lots, showing that many mills are short of supplies. Refiners of *benzene* are quoting 27@33c. per gal. for future delivery. Spot supplies are scarce and odd lots command a premium, with some small sales recorded as high as 40c. per gal. Practically no improvement in coke-oven operations has been made, and as a consequence no great relief can be expected for some weeks to come. Production at present is about 20 per cent normal. Some odd lots of *phenol* have sold at 8@8¼c. per lb., but most prime goods are held at 9@9¼c. on spot. Competition is keen and stocks are still large. *U.S.P. benzoic acid* is quoted at 70c. per lb. and technical at 50@60c., depending upon seller and quantity. Considerable activity is noted in the U.S.P., with the canneries taking the major part of the output.

Offerings of *aniline oil* as low as 18c. per lb. have been made by factors, with 20c. quoted in other directions. Resellers have made sales down to 17¼c. per lb. The tone of the market is weak and some producers are showing a strong desire to liquidate their stocks. Supplies are more than sufficient to take care of the present moderate demand. Makers of *beta naphthol* quote up to 40c. per lb., but on actual business 32c. is the price usually named. Stocks are unusually large and the demand is far from active. Some producers are desirous of realizing cash on their holdings and are shading prices in an attempt to stimulate business. Resellers are quoting 32c. per lb., with a few odd lots recorded as low as 30c. The present prices are said to be below the cost of production and one prominent factor is said to have stopped producing and is supplying his customers from the open market.

Manufacturers of *dimethylaniline* quote 45c. per lb. and upward, depending upon the quantity and seller. The resale market is pegged at 42c. The demand is moderate and shows signs of slight improvement.

The St. Louis Market

St. Louis, Sept. 16, 1921.

While there has been a steady improvement in activity in the drug and fine chemical market, with spot orders being more frequent, it must be granted that the expectations of two months ago have not been fulfilled. It seems that this year there will be no definite demarcation between the summer lull and the fall increase in activity as in former years, but that the improvement will be slow but steady. No further declines to any extent are looked for, as most items are down to prices based on actual costs, and a few are even being offered below the cost of production. The market on heavy chemicals maintains its improvement, with several chemicals enjoying a very strong demand.

Alkalis

Caustic soda demand continues good and the price of $4 per 100 lb., basis 73-75 per cent solid, f.o.b. point of production, is very firm. *Soda ash* demand is only fair, with manufacturers' schedule prevailing. *Bicarbonate of soda* and *sal soda* are in light demand, with the former holding at $2.60@$2.75 per 100 lb. in less than carlots.

Industrials

Carbon bisulphide is scarce, with a very active demand for substantial quantities. The grain elevators are beginning to call for this and also *carbon tetrachloride* to combat the weevil. *Sulphur* is in fair demand, with price of $2.10 per 100 lb. for the commercial in bags.

Chemicals, Drugs, Pharmaceuticals

The demand for *bismuth salts* continues to be very active. *Cream of tartar* is in routine demand. *Ether* demand shows signs of activity, and *motor ether* is beginning to move in anticipation of the winter demand. *Iodides* have increased steadily in demand, and the same holds true for *sodium benzoate*. Prices on the above remain unchanged. *Caffeine alkaloid* is very weak. *Zinc stearate* has been enjoying an excellent demand. *Glycerine* has reacted from its low point of 14c., and now holds at 14½c. per lb., spot and contract, with routine demand.

Acids

Sulphuric acid demand is light. Several manufacturers have stopped production temporarily, and are taking care of orders from storage stocks. *Citric acid* demand is light, with price unchanged. *Tartaric acid* is in routine demand. *Pyrogallic* and *benzoic acids* are both having an active demand and good movement. There is a good demand for

the U.S.P. *carbolic acid*, while the large Government stocks still affect the technical, and demand on the latter is light. *Phosphoric acid* demand is routine.

Vegetable Oils

Linseed oil rose to a maximum of 80c. per gal. before resuming its present price of 78c., basis raw in barrels, ex-warehouse. Most of the demand is for spot oil. *Castor oil* continues in very good demand, with price firm at 11½c. per lb. in drums for No. 1 U.S.P. *Turpentine* demand is routine and the price has advanced to 69c., basis barrels ex-warehouse.

The Iron and Steel Market

PITTSBURGH, Sept. 16, 1921.

There has been no material increase in the past week in the total volume of demand upon the steel mills, but the improvement previously recorded has been held.

Demand is still so light by comparison with productive capacity that the relative increase in demand may be overlooked. A plain distinction must be made between the actual consumption of steel and the demand upon the mills, resulting in production and shipments. On account of the existence of stocks of steel in the hands of buyers, and of finished wares made from steel, the demand upon the mills fell far below a normal relation to the general business activity of the country.

Production constitutes an immediate reflection of the volume of demand, since all buying is of hand-to-mouth character and for the quickest delivery possible. In both sheets and tin plates production is at nearly 45 per cent of capacity, and the tin plate showing is particularly remarkable because normally the fore part of September is approximately the dullest period of the year in tin plate. Pipe mills are operating at about 40 per cent, while wire mills are operating at about 50 per cent on an average. Bar production is at a lower rate, while production of plates, shapes and rails is very small.

Steel Prices

In view of the continued decline in steel prices for so many months, it was rather spectacular that wire products should advance in price but an advance of $2 a ton in plain wire and $3 a ton in barb wire and nails became a fact this week, the American Steel & Wire Co. (Steel Corporation) making the advance effective Monday, Sept. 12, while the independents followed. The new prices are: Plain wire, 2.60c.; galvanized wire, 3.10c.; painted barb wire, 3.05c.; galvanized barb wire, 3.55c.; cement coated nails, $2.50; wire nails, $2.90. An advance in wire prices, however, is not like an advance in steel prices in general.

Bars, shapes and plates are perhaps a shade easier than a week ago, 1.65c. being a more common price, while prices below that, possibly even below 1.60c., are reported as done on especially desirable orders. Sheets remain firm at 2.75c. for black and 3.75c. for galvanized. Two large independent mills, one in the Mahoning Valley and one in the Chicago district, have announced an advance in their prices of $5 a ton, to 3c. and 4c. respectively, but in view of the strenuous competition it seems improbable that an advance of this size will be followed generally.

Prices on tubular products developed early in July were promptly shaded as to oil country goods, but held fairly well until recently as to standard steel pipe. The prospect now is that there will be a formal reduction in recognition of the shading, to a level that may hold.

Generally speaking, it is plain that finished steel prices on an average are very near their bottom with present wage rates and freight rates.

Pig Iron and Coke

Pig iron inquiry is very light, but the little burst of activity recently may be repeated, as there was no forward buying. The market remains quotable at $20 for bessemer, $19 for basic and $21 for foundry, f.o.b. valley furnaces.

Connellsville furnace coke is firm at $3.25, with not much to be had at that level. A fortnight ago the market was $2.90@$3.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	.....	$0.40 - $0.45
Acetone	lb.	$0.12½ - $0.12¾	.13 - .13½
Acid, acetic, 28 per cent	100 lbs.	2.75 - 3.00	3.25 - 3.50
Acetic, 56 per cent	100 lbs.	5.50 - 5.75	6.00 - 6.50
Acetic, glacial, 99½ per cent, carboys, 100 lbs.		10.50 - 11.00	11.25 - 11.50
Boric, crystals	lb.	.12½ - .13	.13½ - .14
Boric, powder	lb.	.13 - .13½	.14 - .14½
Citric	lb.	.....	.45 - .47
Hydrochloric	100 lb.	1.25 - 1.50	1.60 - 1.75
Hydrofluoric, 52 per cent	lb.	.11½ - .11¾	.12 - .12½
Lactic, 44 per cent tech	lb.	.10 - .11	.11½ - .12
Lactic, 22 per cent tech	lb.	.04½ - .05½	.06 - .07
Molybdic, C. P.	lb.	4.00 - 4.50	4.50 - 5.00
Muriatic, 20 deg. (see hydrochloric)		.....	.....
Nitric, 40 deg	lb.	.06½ - .06¾	.07 - .07½
Nitric, 42 deg	lb.	.07 - .07½	.07½ - .07¾
Oxalic, crystals	lb.	.16 - .16½	.17 - .18
Phosphoric, 50 per cent solution	lb.	.13 - .13½	.14 - .18
Picric	lb.	.20 - .25	.27 - .35
Pyrogallic, resublimed	lb.	.....	1.75 - 1.90
Sulphuric, 60 deg., tank cars	ton	.....	11.75 - 13.00
Sulphuric, 60 deg., drums	ton	.....	13.00 - 15.00
Sulphuric, 66 deg., tank cars	ton	18.00 - 20.00	.....
Sulphuric, 66 deg., drums	ton	21.00 - 22.00	22.50 - 23.00
Sulphuric, 66 deg., carboys	ton	.....	.....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	21.00 - 22.00	.....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	23.00 - 23.50	24.00 - 24.50
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.	lb.	.....	.75 - .85
Tannic (tech.)	lb.	.45 - .48	.50 - .55
Tartaric, imported crystals	lb.	.....	.25 - .26
Tartaric acid, imported, powdered	lb.	.....	.27 - .28
Tartaric acid, domestic	lb.	.....	.35
Tungstic, per lb. of WO	lb.	.....	1.30 - 1.40
Alcohol, Ethyl	gal.	.....	4.65 - 4.90
Alcohol, Methyl (see methanol)		.....	.....
Alcohol, denatured, 188 proof	gal.	.....	.35 - .36
Alcohol, denatured, 190 proof	gal.	.....	.37 - .38
Alum, ammonia lump	lb.	.03½ - .03¾	.04 - .04½
Alum, potash lump	lb.	.03½ - .04	.04 - .04½
Alum, chrome lump	lb.	.10 - .11	.11 - .12½
Aluminum sulphate, commercial	lb.	.02 - .02½	.02½ - .02¾
Aluminum sulphate, iron free	lb.	.03 - .03½	.03½ - .04
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07¼ - .07¾	.08 - .08½
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 - .32	.33 - .35
Ammonium carbonate, powder	lb.	.07 - .07½	.08 - .09
Ammonium chloride, granular (white salammoniac)	lb.	.06 - .06½	.06½ - .07
Ammonium chloride, granular (gray salammoniac)	lb.	.06¾ - .07	.07½ - .08
Ammonium nitrate	lb.	.07 - .07½	.07½ - .08½
Ammonium sulphate	100 lb.	2.20 - 2.25	2.30 - 2.40
Amylacetate	gal.	.....	3.25 - 3.50
Amylacetate tech	gal.	.....	2.50 - 3.00
Arsenic oxide, (white arsenic) powdered	lb.	.06 - .06½	.06½ - .07
Arsenic, sulphide, powdered (red arsenic)	lb.	.11 - .11½	.12 - .13
Barium chloride	ton	45.00 - 46.00	47.00 - 50.00
Barium dioxide (peroxide)	lb.	.20 - .21	.22 - .23
Barium nitrate	lb.	.07½ - .08	.08½ - .09
Barium sulphate (precip.) (blanc fixe)	lb.	.04½ - .04¾	.04½ - .05½
Bleaching powder (see calc. hypochlorite)		.....	.....
Blue vitriol (see copper sulphate)		.....	.....
Borax (see sodium borate)		.....	.....
Brimstone (see sulphur, roll)		.....	.....
Bromine	lb.	.27 - .28	.28½ - .30
Calcium acetate	100 lbs.	2.00 - 2.05	.....
Calcium carbide	lb.	.04½ - .04¾	.05 - .05½
Calcium chloride, fused, lump	ton	23.50 - 24.00	24.50 - 25.50
Calcium chloride, granulated	lb.	.01½ - .02	.02½ - .02½
Calcium hypochlorite (bleach powder)	100 lb.	2.75 - 2.80	2.90 - 3.50
Calcium peroxide	lb.	.....	1.40 - 1.50
Calcium phosphate, tribasic	lb.	.....	.15 - .16
Camphor	lb.	.....	.70 - .73
Carbon bisulphide	lb.	.06 - .06½	.06½ - .07½
Carbon tetrachloride, drums	lb.	.10½ - .10¾	.11 - .12
Carbonyl chloride (phosgene)	lb.	.....	.60 - .75
Caustic potash (see potassium hydroxide)		.....	.....
Caustic soda (see sodium hydroxide)		.....	.....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.08 - .09	.09½ - .10
Chloroform	lb.	.....	.38 - .43
Cobalt oxide	lb.	.....	2.00 - 2.10
Copperas (see iron sulphate)		.....	.....
Copper carbonate, green precipitate	lb.	.19 - .19½	.20 - .21
Copper cyanide	lb.	.....	.50 - .62
Copper sulphate, crystals	lb.	.05½ - .05¾	.05½ - .06
Cream of tartar (see potassium bitartrate)		.....	.....
Epsom salt (see magnesium sulphate)		.....	.....
Ethyl Acetate Com. 85%	gal.	.....	1.00 - 1.10
Ethyl Acetate pure (acetic ether 98% to 100%)	lb.	.....	.40 - .42
Formaldehyde, 40 per cent	lb.	.12 - .12½	.12¼ - .13½
Fusel oil, ref.	gal.	.....	3.25 - 3.75
Fusel oil, crude	gal.	.....	1.50 - 1.75
Glauber's salt (see sodium sulphate)		.....	.....
Glycerine, C. P. drums extra	lb.	.....	.14½ - .15
Iodine, resublimed	lb.	.....	3.50 - 3.60
Iron oxide, red	lb.	.....	.10 - .20
Iron sulphate (copperas)	ton	18.00 - 19.00	20.00 - 21.00
Lead acetate	lb.	.....	.10½ - .12½
Lead arsenate, paste	lb.	.09 - .09½	.10 - .11
Lead nitrate	lb.	.....	.15 - .20
Litharge	lb.	.07½ - .08	.08½ - .09
Lithium carbonate	lb.	.....	1.30 - 1.40
Magnesium carbonate, technical	lb.	.08 - .08½	.09 - .10
Magnesium sulphate, U. S. P.	100 lb.	2.50 - 2.75	.....
Magnesium sulphate, technical	100 lb.	.....	1.10 - 1.75
Methanol, 95%	gal.	.....	.66 - .68
Methanol, 97%	gal.	.....	.70 - .72
Nickel salt, double	lb.	.....	.12 - .12½
Nickel salt, single	lb.	.....	.14 - .14½
Phosgene (see carbonyl chloride)		.....	.....
Phosphorus, red	lb.	.40 - .41	.42 - .45
Phosphorus, yellow	lb.	.....	.30 - .35
Potassium bichromate	lb.	.11½ - .11¾	2 - .12½

		Carlots	Less Carlots
Potassium bitartrate (cream of tartar)	lb.	$ - $	$0.28½–$0.29½
Potassium bromide, granular	lb.	-	.16 – .25
Potassium carbonate, U. S. P.	lb.	.35 – .40	.45 – .50
Potassium carbonate, 80–85%	lb.	.05 – .05½	.06 – .06½
Potassium chlorate, crystals	lb.	.07 – .07½	.07½– .10
Potassium cyanide	lb	-	.26 – .28
Potassium hydroxide (caustic potash)	lb.	.04½– .04¾	.05 – .06
Potassium muriate, 80% K.C.L.	ton	42.50 – 45.00	-
Potassium iodide	lb.	-	2.75 – 3.00
Potassium nitrate	lb.	.09½– .09½	.10 – .12½
Potassium permanganate	lb.	.22 – .23	.24 – .25
Potassium prussiate, red	lb.	.28 – .29	.29½– .30
Potassium prussiate, yellow	lb.	.20 – .20½	.21 – .22
Potassium sulphate (powdered)	per unit	-	1.20 – 1.25
Rochelle salts (see sodium potas tartrate)			
Salammoniac (see ammonium chloride)			
Sal soda (see sodium carbonate)			
Salt cake (bulk)	ton	-	20.00 –25.00
Silver cyanide	oz.	-	1.35 – 1.38
Silver nitrate	oz.	-	.41½– .42
Soda ash, light	100 lb.	2.00 – 2.10	2.15 – 2.50
Soda ash, dense	100 lb.	2.35 – 2.40	2.45 – 2.70
Sodium acetate	lb.	.04 – .04½	.04½– .05
Sodium bicarbonate	100 lb.	2.00 – 2.25	2.50 – 2.75
Sodium bichromate	lb.	.07½– .08	.08½– .08½
Sodium bisulphate (nitre cake)	ton	5.00 – 5.25	5.50 – 6.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½– .05	.05½– .06
Sodium borate (borax)	lb.	.05½– .06	.06½– .07
Sodium carbonate (sal soda)	100 lb.	1.90 – 2.00	2.10 – 2.40
Sodium chlorate	lb.	.07½– .07¾	.08 – .08½
Sodium cyanide	lb.	.19½– .21	.22 – .30
Sodium fluoride	lb.	.10½– .11	.11½– .12
Sodium hydroxide (caustic soda)	100 lb.	3.90 – 4.00	4.10 – 4.60
Sodium hyposulphite	lb	-	.03½– .03½
Sodium nitrate	100 lb.	2.10 – -	2.30 – -
Sodium nitrite	lb.	.07 – .07½	.07½– .08
Sodium peroxide, powdered	lb.	.25 – .26	.27 – .30
Sodium phosphate, dibasic	lb.	.04½– .04¾	.05 – .05½
Sodium potassium tartrate (Rochelle salts)	lb.	-	.21 – .24
Sodium prussiate, yellow	lb.	.12½– .13	.13½– .13¾
Sodium silicate, solution (40 deg.)	100 lb.	1.00 – 1.15	1.25 – 1.40
Sodium silicate, solution (60 deg.)	lb.	.02½– .03	.03½– .03¾
Sodium sulphate, crystals (Glauber's salt)	100 lbs.	1.50 – 1.75	2.00 – 2.25
Sodium sulphide, fused, 60-62 per cent (cone.)	lb.	.04½– .04¾	.05 – .06
Sodium sulphite, crystals	lb.	.03½– .04	.04½– .04½
Strontium nitrate, powdered	lb.	.12 – .12½	.13 – .14
Sulphur chloride, red	lb.	.05 – .05½	.05½– .06½
Sulphur, crude	ton	18.00 –20.00	-
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	-	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	-	2.00 – 2.75
Tin bichloride, 50 per cent	lb.	.18 – .19	-
Tin oxide	lb.	-	.38 – .40
Zinc carbonate, precipitate	lb.	.16 – .16½	.17 – .17½
Zinc chloride, gran	lb.	.09½– .09½	.10 – .11
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc dust	lb.	.11½– .11½	.11½– .12½
Zinc oxide, XX	lb.	.07½– .07½	.08 – .09
Zinc sulphate	100 lb.	3.00 – 3.25	3.30 – 3.50

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb.	$1.15 — $1.20
Alpha-naphthol, refined	lb.	1.35 — 1.40
Alpha-naphthylamine	lb.	.35 — .40
Aniline oil, drums extra	lb.	.17½— .20
Aniline salts	lb.	.24 — .26
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.00 — 1.25
Benzidine, base	lb.	1.00 — 1.10
Benzidine sulphate	lb	.75 — .85
Benzoic acid, U.S.P.	lb.	.70 — .72
Benzoate of soda, U.S.P.	lb.	.55 — .60
Benzene, pure, water-white, in drums (100 gal.)	gal.	.27 — .32
Benzene, 90%, in drums (100 gal.)	gal.	.25 — .28
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.50 — 4.00
Beta-naphthol, sublimed	lb.	.70 — .75
Beta-naphthol, tech	lb.	.32 — .35
Beta-naphthyla mine, sublimed	lb.	1.90 — 2.00
Cresol, U. S. P., in drums (100 lb.)	lb.	.17 — .19
Ortho-cresol, in drums (100 lb.)	lb.	.25 — .27
Cresylic acid, 97–99%, straw color, in drums	gal.	.70 — .75
Cresylic acid, 95-97%, dark, in drums	gal.	.60 — .65
Cresylic acid, 50%, first quality, drums	gal.	.45 — .50
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	1.20 — 1.25
Dimethylaniline	lb.	.42 — .50
Dinitrobenzene	lb.	.25 — .28
Dinitroclorbenzene	lb.	.25 — .30
Dinitronaphthalene	lb.	.32 — .40
Dinitrophenol	lb.	.37 — .40
Dinitrotoluene	lb.	.25 — .30
Dip oil, 25%, car lots, in drums	gal.	.35 — .40
Diphenylamine	lb.	.60 — .70
H-acid	lb.	1.10 — 1.20
Meta-phenylenediamine	lb.	1.15 — 1.20
Monochlorbenzene	lb.	.12 — .14
Monoethylaniline	lb.	1.50 — 1.60
Naphthalene crushed, in obls.	lb.	.06½— .07½
Naphthalene, flake	lb.	.06½— .08
Naphthalene, balls	lb.	.08 — .09½
Naphthionic acid, crude	lb.	.70 — .75
Nitrobenzene	lb.	.12 — .15
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	.15 — .17
Ortho-amidophenol	lb.	3.00 — 3.10
Ortho-dichlor-benzene	lb.	.15 — .20
Ortho-nitro-phenol	lb.	.75 — .80
Ortho-nitro-toluene	lb.	.15 — .20
Ortho-toluidine	lb.	.23 — .25
Para-amidophenol, base	lb.	1.40 — 1.45
Para-amidophenol, HCl	lb.	1.70 — 1.80
Para-dichlorbenzene	lb.	.15 — .20
Paranitroaniline	lb.	.79 — .82
Para-nitrotoluene	lb.	.80 — .85
Para-phenylenediamine	lb.	1.70 — 1.75
Para-toluidine	lb.	1.25 — 1.40
Phthalic anhydride	lb.	.40 — .50
Phenol, U. S. P., drums	lb.	.08½— .10
Pyridine	gal.	2.00 — 3.50
Resorcinol, technical	lb.	1.50 — 1.60
Resorcinol, pure	lb.	2.25 — 2.30
Salicylic acid, tech., in bbls.	lb.	.18 — .20
Salicylic acid, U. S. P.	lb.	.20 — .25
Salol	lb.	.60 — .70
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.25 — .28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14 — .16
Sulphanilic acid, crude	lb.	.27 — .30
Tolidine	lb.	1.30 — 1.35
Toluidine, mixed	lb.	.43 — .45
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.28 — .31
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — -
Xylene, commercial, in drums, 100 gal	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — -

Waxes

Prices based on original packages in large quantities.

Bayberry Wax	lb.	$0.20 — $0.21
Beeswax, refined, dark	lb.	.24 — .25
Beeswax, refined, light	lb.	.28 — .30
Beeswax, white pure	lb.	.36 — .42
Candelilla wax	lb.	.25 — .26
Carnauba, Flora	lb.	.48 — .50
Carnauba, No. 2, North Country	lb.	.25 — .26
Carnauba, No. 3, North Country	lb.	.15 — .15½
Japan	lb.	.23 — .24
Montan, crude	lb.	.05½— .06
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.03½— .03½
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02 — -
Paraffine waxes, refined, 118-120 m.p.	lb.	.03 — .03½
Paraffine waxes, refined, 125 m.p.	lb.	.03½— .03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.03½— .04½
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½— .05
Paraffine waxes, refined, 135-137 m.p.	lb.	.05½— .06
Stearic acid, single pressed	lb.	.09½— -
Stearic acid, double pressed	lb.	.10½— -
Stearic acid, triple pressed	lb.	.11 — .11½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$5.40 —	5.50
Rosin E-I	280 lb.	5.50 —	5.60
Rosin K-N	280 lb.	5.75 —	5.90
Rosin W. G.-W. W.	280 lb.	6.60 —	7.35
Wood rosin, bbl.	280 lb.	6.25 —	-
Spirits of turpentine	gal.	.70 —	-
Wood turpentine, steam dist.	gal.	.68 —	-
Wood turpentine, dest. dist.	gal.	.66 —	-
Pine tar pitch, bbl.	200 lb.	- —	7.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	- —	11.00
Retort tar, bbl.	500 lb.	—	11.00
Rosin oil, first run	gal.	.35 —	-
Rosin oil, second run	gal.	.37 —	-
Rosin oil, third run	gal.	.44 —	-
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		$1.90
Pine oil, pure, dest. dist.	gal.		1.50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.35
Turpentine, crude, sp. gr., 0.900-0.970	gal.		1.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.35
Pinewood creosote, ref.	gal.		.52

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.37
70-72 deg., steel bbls. (85 lb.)	gal.	.35
68-70 deg., steel bbls. (85 lb.)	gal.	.34
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.23

Crude Rubber

Para—Upriver fine	lb.	$0.16 —	.17
Upriver coarse	lb.	.09 —	.09½
Upriver caucho ball	lb.	.11½ —	.12
Plantation—First latex crepe	lb.	.14 —	-
Ribbed smoked sheets	lb.	.12 —	.12½
Brown crepe, thin, clean	lb.	.15 —	-
Amber crepe No. 1	lb.	.17 —	-

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.09½ —	$0.09½
Castor oil, AA, in bbls.	lb.	.10½ —	.11
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	.11 —	.11½
Cocoanut oil, Ceylon grade, in bbls.	lb.	.10 —	.10½
Cocoanut oil, Cochin grade, in bbls.	lb.	.10½ —	.11½
Corn oil, crude, in bbls.	lb.	.08½ —	.08½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08 —	.08½
Cottonseed oil, summer yellow	lb.	.10 —	.10½
Cottonseed oil, winter yellow	lb.	.10½ —	.11
Linseed oil, raw, car lots (domestic)	gal.	.77 —	.78
Linseed oil, raw, tank cars (domestic)	gal.	.71 —	.72
Linseed oil, in 5-bbl lots (domestic)	gal.	.80 —	.81

Olive oil, Denatured	gal.	$1.10	— $1.20
Palm, Lagos	lb.	.07½	— .08
Palm, Niger	lb.	.06½	— .06¾
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08	— .08½
Peanut oil, refined, in bbls	lb.	.10½	— .10¾
Rapeseed oil, refined in bbls	gal.	.86	— .88
Rapeseed oil, blown, in bbls	gal.	.90	— .92
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.08½	— ....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.06½	— ....
FISH			
Light pressed menhaden	gal.	$0.40	— ....
Yellow bleached menhaden	gal.	.42	— ....
White bleached menhaden	gal.	.44	— ....
Blown menhaden	gal.	.48	— ....

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$24.00	— 30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22.00	— 26.00
Barytes, crude, 88%@94% ba., Kings Creek	net ton	10.00	— 12.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00	— 24.00
Barytes, crude, first grade, Missouri	net ton	7.00	— ....
Blanc fixe, dry	lb.	.04	— .04½
Blanc fixe, pulp	net ton	45.00	— 55.00
Casein	lb.	.06	— .07
Chalk, Precipitated, domestic, extra light	lb.	.04½	— .05
Chalk, Precipitated, domestic, light	lb.	.04	— .04½
Chalk, Precipitated, domestic, heavy	lb.	.03½	— .04
Chalk, Precipitated, English, extra light	lb.	.04½	— .05
Chalk, Precipitated, English, light	lb.	.04½	— .05
Chalk, Precipitated, English, dense	lb.	.04	— .04½
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.50	— 8.50
China clay (kaolin) washed, f.o.b. Georgia	net ton	9.00	— 10.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	13.00	— 20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	— 12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	13.00	— 20.00
China clay (kaolin), imported, lump	net ton	12.00	— 20.00
China clay (kaolin), imported, powdered	net ton	25.00	— 30.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	net ton	5.00	— 7.50
Feldspar, crude, f.o.b. Maine	net ton	7.50	— 10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00	— 23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00	— 21.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00	— 21.00
Feldspar, ground, f.o.b. Baltimore	net ton	27.00	— 30.00
Fullers earth, f.o.b. Mines	net ton	16.00	— 17.00
Fullers earth, granular, f.o.b. Pa	net ton	15.00	— 18.00
Fullers earth, powdered, f.o.b. Fla	net ton	18.00	— ....
Fullers earth, imported, powdered	net ton	24.00	— 27.00
Graphite, Ceylon lump, first quality	lb.	.06	— .07
Graphite, Ceylon chip	lb.	.04½	— .05
Graphite, high grade amorphous crude	lb.	.00½	— .02½
Kieselguhr, f.o.b. mines, Cal	per ton	40.00	— ....
Kieselguhr, f.o.b. N.Y	per ton	61.00	— ....
Magnesite, calcined	per ton	66.00	— 70.00
Pumice stone, imported, lump	lb.	.03	— .40
Pumice stone, domestic lump	lb.	.05	— .05½
Pumice stone, ground	lb.	.06	— .07
Quartz (acid tower) first to head, f.o.b. Baltimore	net ton	....	— 10.00
Quartz (acid tower) 1½@2 in., f.o.b. Baltimore	net ton	....	— 14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	....	— 17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00	— 7.50
Shellac, orange fine	lb.	.50	— .51
Shellac, orange superfine	lb.	.51	— .52
Shellac, A. C. garnet	lb.	.44	— .45
Shellac, T. N	lb.	.44	— .45
Soapstone	ton	12.00	— 15.00
Sodium chloride	long ton	12.50	— 13.00
Talc, paper-making grades, f.o.b. Vermont	ton	11.00	— 18.00
Talc, roofing grades, f.o.b. Vermont	ton	8.50	— 13.00
Talc, rubber grades, f.o.b. Vermont	ton	11.00	— 18.00
Talc, powdered, Southern, f.o.b. cars	ton	7.50	— 11.00
Talc, imported	ton	30.00	— 40.00
Talc, California talcum powder grade	ton	18.00	— 25.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh	per ton		$50.00
Carborundum refractory brick, 9-in. — less than carlot	1,000		1250.00
Carborundum refractory brick, 9-in. — carload lots	1,000		1100.00
Chrome brick, f.o.b. Eastern shipping points	net ton		52– 55
Chrome cement, 40–45% Cr_2O_3	net ton		30– 32
Chrome cement, 40–45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton		33– 35
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000		35– 40
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000		30– 35
Magnesite brick, 9-in. straight	net ton		65– 70
Magnesite brick, 9-in. arches, wedges and keys	net ton		77
Magnesite brick, soaps and splits	net ton		98
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000		40– 42
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000		42– 45
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000		35– 38

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y	net ton	$200.00	— $225.00
Ferrochrome per lb. of Cr. contained, 6–8% carbon, carlots	lb.	.11	— ....
Ferrochrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.11	— .12
Ferromanganese, 76-80% Mn, domestic	net ton	65.00	— 67.00
Ferromanganese, 76-80% Mn, English	net ton	65.00	— 67.00
Spiegeleisen, 18-22% Mn	net ton	25.00	— 27.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.25	— ....
Ferrosilicon, 10-15%	net ton	38.00	— 40.00
Ferrosilicon, 50%	net ton	60.00	— 65.00
Ferrosilicon, 75%	net ton	130.00	— 135.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.40	— .45
Ferrouranium, 35-50% of U, per lb. of U content	lb.	6.00	— ....
Ferrovanadium, 30-40% per lb. of contained V	lb.	4.25	— 4.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content	net ton	$8.00	— $10.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	25.00	— 27.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	25.00	— 27.00
Coke, foundry, f.o.b. ovens	net ton	4.25	— 4.50
Coke, furnace, f.o.b. ovens	net ton	3.00	— 3.25
Coke, petroleum, refinery, Atlantic seaboard	net ton	14.00	— 15.00
Fluorspar, lump, f.o.b. mines, New Mexico	net ton	12.50	— ....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	20.00	— 22.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½	— .01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.20	— .21
Manganese ore, chemical (MnO_2)	net ton	50.00	— 55.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.55	— .60
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	30.00	— ....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.12	— .12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12	— .12
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	.11	— .12
Rutile, 95% TiO_2 per lb. ore	lb.	.15	— ....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	2.75	— 3.00
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	3.00	— 3.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.50	— 2.50
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25	— 2.50
Vanadium pentoxide, 99%	lb.	12.00	— 14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00	— ....
Zircon, washed, iron free	lb.	.03	— ....

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic	12.125
Aluminum, 98 to 99 per cent	24.5@25
Antimony, wholesale lots, Chinese and Japanese	4.45@4.50
Nickel, ordinary (ingot)	41.00
Nickel, electrolytic	44.00
Monel metal, shot and blocks	35.00
Monel metal, ingots	38.00
Monel metal, sheet bars	40.00
Tin, 5-ton lots, Straits	26.50
Lead, New York, spot	4.60
Lead, E. St. Louis, spot	4.40
Zinc, spot, New York	4.50@4.55
Zinc, spot, E. St. Louis	4.175

OTHER METALS

Silver (commercial)	oz.	$0.63½
Cadmium	lb.	1.00–1.25
Bismuth (500 lb. lots)	lb.	1.50@1.55
Cobalt	lb.	3.00@3.25
Magnesium (f.o.b. Philadelphia)	lb.	1.25
Platinum	oz.	72.00@78.00
Iridium	oz.	160.00@170.00
Palladium	oz.	52.00–55.00
Mercury	75 lb.	42.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	19.50
Copper bottoms	27.00
Copper rods	18.00@18.75
High brass wire	15.75
High brass rods	13.25
Low brass wire	17.25
Low brass rods	17.25
Brazed brass tubing	25.00
Brazed bronze tubing	29.75
Seamless copper tubing	19.50
Seamless high brass tubing	18.30

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current	Cleveland	Chicago
Copper, heavy and crucible	9.00@ 9.25	9.25	9.50
Copper, heavy and wire	8.25@ 8.50	8.50	8.50
Copper, light and bottoms	7.00@ 7.25	7.50	7.25
Lead, heavy	3.00@ 3.25	3.25	3.25
Lead, tea	2.25@ 2.35	2.25	2.25
Brass, heavy	4.00@ 4.25	4.50	5.00
Brass, light	3.00@ 3.25	3.25	3.50
No. 1 yellow brass turnings	3.75@ 4.00	4.25	4.50
Zinc	2.00@ 2.25	2.00	2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Cleveland	Chicago
Structural shapes	$2.88	$2.88	$2.88
Soft steel bars	2.78	2.78	2.78
Soft steel bar shapes	2.78	2.78	2.78
Soft steel bands	3.42	3.48	3.48
Plates, ¼ to 1 in. thick	2.88	2.80	2.80

*Add 15c per 100 lb. for trucking to Jersey City and 10c for delivery in New York and Brooklyn

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

BIRMINGHAM—The Wofford Oil Co., has plans under way for extensions and improvements in its plant to cost about $750,000. A large portion of the work will cover the installation of equipment for gasoline production.

Georgia

COLUMBUS—The Columbus Sewer Pipe Co., manufacturer of vitrified pipe, is considering the rebuilding of the portion of its plant recently destroyed by fire with loss estimated at about $75,000. Judson C. Buchanan is manager.

Kentucky

ASHLAND—The Norton Iron Works will commence the immediate construction of a new 2-story plant addition, 150 x 200 ft., for the manufacture of wire screen cloth and kindred products. T. M. Adams is president and general manager.

LOUISVILLE — The Progress Pressed Brick Co. has perfected plans for the erection of a 1-story addition to increase the plant capacity from about 20,000 to 45,000 bricks a day. A. P. Hildebrand is president.

Louisiana

NEW ORLEANS — The Maryland Refining Co. has broken ground for the erection of its proposed new oil refinery on site recently acquired, estimated to cost in excess of $1,000,000 with machinery.

NEW ORLEANS—The Colonial Chemical Co. has acquired a local site and plans for the erection of a new plant. Headquarters are at Reading, Pa.

Maine

RUMFORD—Owing to labor troubles, the Continental Paper & Bag Co., is arranging for the removal of its local paper manufacturing plant to a new location. The mills wil be dismantled at once.

Maryland

BALTIMORE—The United States Industrial Chemical Co., Curtis Bay, has filed plans for the erection of a new 1-story plant on Fairfield Ave. Work will be commenced at once.

Massachusetts

BELMONT — The Campbell & Wiswell Co., Boston, Mass., manufacturer of paints, varnishes, etc., has completed plans for the erection of a new 1-story, brick and reinforced-concrete plant on Hittinger St., about 60 x 90 ft.

Michigan

MONROE—The Monroe Paper Products Co. has commenced operations at its new local mill, recently completed, for the manufacture of folding boxboard and other paper products. The initial daily output will average about 75 tons, with the plant giving employment to close to 100 men. The company is said to have orders on hand to insure continuous production for an indefinite period. William R. Harris is president and Roy M. Sperry, secretary.

MONROE—The Consolidated Paper Co. has preliminary plans under way for the erection of a new mill for the manufacture of strawboard and affiliated paper products. E. C. Bauch is president.

DETROIT—The Solvay Process Co. has arranged for the resumption of production at its plant at Delray, near Detroit, following a shut-down for the past two months. The works will give employment to about 1,500 operatives for initial manufacture.

KALAMAZOO — Peter King, formerly president of the Monarch Paper Co., and associates are said to be planning for the organization of a new company, capitalized at $20,000, for the erection of a local plant for the reclaiming of sulphite and ground wood from newspaper and other grades of paper goods, the material to be used for the re-manufacture of paper products. The initial works will be equipped for a daily capacity of about 50 tons of material.

Mississippi

GREENVILLE — The Rainbow Oil Co., recently organized with a capital of $500,000 by E. L. Wortham, El Dorado, Ark., and associates, has plans under way for the erection of a new oil-refining plant near Greenville.

Missouri

KANSAS CITY—The Corn Products Refining Co., 11 Battery Pl., New York, is planning for the construction of a new refinery at Kansas City. The plant will consists of a total of 16 buildings, with tanks and other miscellaneous structures, estimated to cost about $5,000,000 with machinery. It will have an initial handling capacity of about 25,000 bush. of corn.

New Jersey

NEWFIELD—The Wilcox Durand Glass Co. is taking bids for the erection of a new 1-story plant extension, 31 x 101 ft., to be used for machine and other repair service. The W. P. Cameron Engineering Co., Witherspoon Bldg., Philadelphia, Pa., is architect and engineer.

KEASBEY — The National Fireproofing Co. has arranged for the resumption of production of hollow tile and other burned clay products, at its local plant, following a shut-down of several months' duration.

TRENTON — Fire recently destroyed a portion of the plant of the Acme Pottery Co., May and Beakes Sts., manufacturer of sanitary earthenware, with loss estimated at about $50,000. The company is said to be planning for immediate rebuilding.

New York

NIAGARA FALLS—The Niagara Falls Felt & Paper Co., a subsidiary of the Niagara Falls Power Co., Canal Basin, has awarded a contract to the Read & Coddington Engineering Co., 238 Portage Road, for the erection of a new local plant, estimated to cost about $300,000, including equipment.

TONAWANDA—Fire, Sept. 7, destroyed a plant portion of the plant of the Frontier Mfg. Co., Erie Ave., manufacturer of oil products, with loss estimated at about $35,000.

Ohio

DAYTON — The Refiners Oil Co. has awarded a contract to the Dayton Asphalt Roofing Dayton, for the erection of a new 1-story plant on South Ludlow St., 60 x 100 ft.

TOLEDO—The Spitzer Paper Box Co., 3501 Monroe St., is planning for the erection of a new 3-story plant, 30 x 80 ft., on local site, estimated to cost about $50,000. It will be used as an extension to the present works. George R. Rheinfrank, Gardner Bldg., is architect.

Oklahoma

HENRYETTA — The Henryetta Glass Co., recently organized with a capital of $50,000, has acquired a local site, totaling about 2 acres, for the erection of its proposed new plant for the manufacture of globes shades and other glassware for lighting services. H. L. Chambers is head.

Pennsylvania

PITTSTON — The Luzerne Cut Glass Works has resumed operations at its local plant following a shut-down of several months.

QUARRYVILLE — The Franklin Paper Bag Co., 305 Race St., Philadelphia, has plans under way for the erection of a new local plant about 50 x 75 ft., for the manufacture of its general line of paper products.

NEWCASTLE—The Universal Sanitary Mfg. Co., manufacturer of sanitary earthenware and other pottery products, is arranging for the immediate resumption of operations at its plant, following a shut-down for a number of months past. The works will give employment to about 250 men.

DU BOIS—The Pittsburgh Lens Glass Co., Pittsburgh, will make a number of improvements and extensions at its plant at Falls Creek, remodeling certain portions of the works. It is planned to place the factory in operation at an early date.

DU BOIS—The Reliance Glass Co. will resume active production at its local plant at an early date, giving employment to about 250 men. Operations have been curtailed for a number of weeks past.

PHILADELPHIA—The Franklin Sugar Refining Co., South Orianna St., has awarded a contract to J. W. Paxson, 1021 North Delaware Ave., for the construction of a new building at its plant at Algon and Luzerne Sts., estimated to cost about $85,000. The company will also make extensions and improvements in its power house at Reed and Meadow Sts. to cost about $20,000.

NEW HOPE—The American Clay Products Co. is planning for the early operation of its new local plant, now in course of construction, for the manufacture of bricks. It is proposed to develop an initial output of about 250,000 vitrified bricks per day, and which amount will be increased at a later date. The plant will cost in excess of $700,000.

Texas

FORT WORTH — The Texas Imperial Co., Fort Worth, is planning for the erection of a new oil refinery in the vicinity of Minerva, with initial capacity of about 100 bbl. a day.

STAMFORD — The Rule-Jayton Cotton Oil Co., recently organized with a capital of $200,000, is planning for the erection of a large cotton oil mill on local site. C. M. Francis heads the company.

HOUSTON—The Texas Co. is arranging for the organization of a subsidiary organization for the development of sulphur properties in Mexico, comprising about 28,000 acres of land. It is proposed to establish a large production plant at the site.

SOMERSET—The Eggleston Oil Corp. is planning for the erection of a new oil refinery on local site to cost about $60 000. It is proposed to develop an initial capacity of about 800 bbl. per day.

AMARILLO — The Plains Lubricating Co., recently organized, will operate a local plant for the production of lubricating oils. It is planned to operate on a basis of 50 drums of material per day.

Virginia

ROANOKE—The Roanoke Fiber Board Co. is completing plans for the rebuilding of its local plant, destroyed by fire last July. Bids for erection will be asked at an early date.

LYNCHBURG — The Lynchburg Glass Co. is arranging for the rebuilding of the portion of its plant recently destroyed by fire with loss estimated at about $12,000. N. D. Eller is president.

PORTSMOUTH—The Texas Co., Houston, Tex., and 17 Battery Pl., New York, N. Y., is considering the erection of a new local oil manufacturing plant.

West Virginia

BELLE—The Belle Alkali Co. will take bids at once for the erection of a new 1-story plant on local site to cost about $50,000. A list of equipment for installation has been arranged.

Wisconsin

SHEBOYGAN — The Falls Roller Mills have had plans prepared for the erection of a new local 5-story and basement flour mill, 50 x 60 ft., estimated to cost about $125,000. E. Gozenbach is manager.

MADISON—The Malvorine Oil Co., 815 East Main St., will make extensions and improvements in its local works on Main St., estimated to cost about $15,000.

SHEBOYGAN—The Trelling Kiel Oil Co., Calumet Drive, has awarded a contract to Verhulst Bros., 1621 Eddie Ave., for the erection of a new 1-story and basement plant building, 50 x 150 ft., estimated to cost about $50,000.

Mexico

TAMPICO—The Corona Oil Co. is planning for the immediate erection of the second unit of its new local refining plant, to have a daily output of about 15,000 bbl. of material per day. The company has completed the construction of the first unit of the new plant. The total cost of the plant, including pipe lines, pumping stations, etc., will be in excess of $5,000,000.

New Companies

THE BINGOL CHEMICAL CO., 2816 South Michigan Ave., Chicago, Ill., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are J. P. Davidonis, M. Jurgelonis and Andrew J. Bloomberg.

NEWSTADT BROS., INC., Wilmington, Del., has been incorporated with a capital of $99,000, to manufacture paints, varnishes, etc. The incorporators are Samuel, Louis and Albert Newstadt, Wilmington. Harry P. Joslyn, Ford Bldg., represents the company.

THE ANCHOR OIL CORP., New York, N. Y., has been incorporated with a capital of $100,000, to manufacture refined oil products. The incorporators are M. Berman, E Weil and M. M. Sherower. The company is represented by H. Schapiro, 261 Broadway.

THE ALLYNDALE LIME CO., 235 State St., Hartford, Conn., has been organized to manufacture lime and affiliated products. W. C. Brooks, 479 West Main St., Meriden, Conn., is president; J. W. MacDonald, vice-president; and T. H. Goodrich, secretary-treasurer, 273 Washington St., Hartford.

W. N. WRIGHT, INC., Boston, Mass., has been incorporated with a capital of $25,000 to manufacture chemicals, dyes and affiliated products. Wallace N. Wright is president; and Robert F. Wright, 212 Columbus Ave., treasurer.

THE PORTEOUS PRODUCTS CORP., New York, N. Y., has been incorporated with a capital of $25,000 to manufacture rubber goods. The incorporators are A. G. Porteous, F. L. Woodward and W. R. Chamberlain. The company is represented by H. C. Knoeppel, 5 Beekman St.

THE AETNA CHEMICAL CO., Newark, N. J., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are Gustave B. Feldman, S. H. Barnett and Vincent Aregena. The company is represented by Aaron Levinston, 20 Clinton St.

THE MCCARTHY FOUNDRY CO., 3307 South Lawndale Ave., Chicago, Ill., has been incorporated with a capital of $300,000, to manufacture iron, steel and other metal castings. The incorporators are John C. Haswell, John J. Carroll and John P. Wheland.

THE ORLANDO POTTERIES, INC., Orlando, Fla., has been incorporated with a capital of $25,000, to manufacture china and earthenware products. M. J. Daetwyler, Orlando, is president; and G. D. Krebs, secretary-treasurer.

THE GUARD-GOOD CHEMICAL CORP., Geneva, N.Y., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are L. H. and C. F. Guard, and G. G. Goodelle. G. I. Teter, Geneva, represents the company.

THE LOS ANGELES BRASS FOUNDRY, 2052 East Vernon Ave., Vernon, Cal., has filed notice of organization to manufacture brass, bronze and other metal castings. T. J. Morgozewitz, 416 Vernon Ave., Los Angeles, Cal., heads the company.

THE VICTORY SOAP JELLY CO., Ilion, N. Y., has been incorporated with a capital of $25,000, to manufacture soaps and affiliated products. The incorporators are A., E. H. and W. B. Loomis, Ilion. The company is represented by J. A. McFarren, Ilion.

THE GARFIELD PETROLEUM CO., Enid, Okla., has been incorporated with a capital of $100,000, to manufacture petroleum products. J. E. Sharp, Enid, is president; and Burton E. Moore, treasurer.

THE WATERPROOF PRODUCTS CO., 56 North Eighteenth St., East Orange, N. J., has filed notice of organization to manufacture waterproofing products, chemical specialties, etc. Leon Flacker heads the company.

JOHN F. WALSH & CO., New York, N. Y., has been incorporated with a nominal capital of $5,000, to manufacture composition products. The incorporators are J. F. and J. J. Walsh and J. J. Maier. The company is represented by C. N. Rogers, 347 Fifth Ave.

THE TRADE COMPOSITION METAL CO., 538 South Dearborn St., Chicago, Ill., has been incorporated with a capital of $15,000, to manufacture composition metal goods and kindred products. The incorporators are Julius C. Greenbaum, William S. Newburger and Maurice C. Handelman.

THE PACIFIC COAST TIRE & RUBBER MFG. CO., Los Angeles, Cal., has been incorporated with a capital of $2,000,000, to manufacture tires and other rubber products. The incorporators are William B. Wightman, W. O. Bruess and Owen C. Emery, 106-A East Broadway, Glendale, Cal.

THE NASSAU FERTILIZER & OIL CO., Fernandina, Fla., has been incorporated with a capital of $500,000, to manufacture fertilizers, oil products, etc. J. B. Guess, Jr., is president, and W. H. Faust, secretary-treasurer, both of Denmark, S. C.

THE KEENTON CO., New York, N. Y., has been incorporated with a capital of $10,000 to manufacture chemicals, chemical byproducts, etc. The incorporators are E. Gettinger, L. Weisberg and S. B. Lilienstern, 280 Broadway.

THE BENJAMIN PRODUCTS CORP., Jersey City, N. J., has been incorporated with a capital of $1,000,000, to manufacture rubber products, gutta percha specialties, etc. The incorporators are Robert A. Van Voohiss, Arthur R. Oakley and William E. Schiels, Jr. The company is represented by the Registrar & Transfer, 900 Market St., Wilmington, Del.

WILLIS BROS., INC., Jersey City, N. J., has been incorporated with a capital of $25,000, to manufacture refined oil products. The incorporators are Merwin Rosenberg, Harry W. and William C. Willis, 245 Custer Ave.

THE TRIANGLE PRODUCING & REFINING CO., Los Angeles, Cal., has been incorporated with a capital of $500,000, to manufacture petroleum products. The incorporators are John G. Clark, G. J. Knight and S. J. Bowman. The company is represented by Carnahan & Clark, 501 Investment Bldg., Los Angeles.

PERCIVAL E. FALKINGHAM, INC., New York, N. Y. has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are P. E. and K. E. Falkingham, and M. D. Craig. The company is represented by L. S. Posner, 15 Broad St.

THE HYGRADE GOLD STAMPING CO., Newark, N. J., has been incorporated with a capital of $50,000, to manufacture stamped gold and other metal stampings. The incorporators are Isadore Silberman, and Jacob Alperun, 83 Wickliffe St.

THE GENERAL ALUMINUM CO., Knoxville, Tenn., has been incorporated with a capital of $60,000, to manufacture aluminum and other metal products. The incorporators are E. H. Hickman, F. G. Arnett and H. B. Lindsay.

THE EYERS DRUG & CHEMICAL CO., Gloucester, Mass., has been incorporated with a capital of $25,000, to manufacture chemicals, chemical byproducts, etc. G. P. Eyers is president; and Herbert H. Eyers, 175 Western Ave., Gloucester, treasurer.

GEORGE V. GROSS & CO, INC., New York, N. Y., has been incorporated with a capital of $20,000, to manufacture oils, extracts and affiliated products. The incorporators are G. V. and G. E. Gross, and A. Davis. The company is represented by Cohen Bros., 35 Wall St.

THE PEQUOT MFG. CORP., New York, N. Y., has been incorporated with a capital of $100,000, to manufacture paper products, paper boxes, etc. The incorporators are E. J. London, N. Bogin and M. L. Arnstein, 320 Broadway.

THE TRENT RUBBER CO., Trenton, N. J., has been incorporated with 10,000 shares of stock, no par value, to manufacture rubber products. The incorporators are William V. Lee, I. M. Martino and George Gildea. The company is represented by Thomas H. Thropp, Enterprise Ave.

THE MILLS-PENFIELD CORP., New York, N Y., has been incorporated with a capital of $20,000, to manufacture paper products. The incorporators are I. Mills, C. H. Penfield and J. Cohen, 7 West Eighth St.

THE HOPWOOD RETINNING CO., 459 Main St., Charlestown, Mass., has filed notice of organization to manufacture metal products. John A. Hopwood heads the company.

THE FLYNN SPECIALTIES CO., New York, N. Y., has been incorporated with a capital of $200,000, to manufacture spark plugs and kindred products. The incorporators are J. F. and A. L. Flynn, and S. M. Platt, 908 Brook Ave., Bronx.

THE VACUUM FLOTATION CORP., New York, N. Y., has been incorporated with a capital of $50,000 to manufacture chemical products. The incorporators are C. M. Chapman, C. S. Clark and C. P. Northrup, 31 Nassau St.

THE INSULATION & SPECIALTY CORP., Wilmington, Del., has been incorporated with a capital of $500,000, to manufacture insulation products, fiber specialties, etc. The incorporators are W. L. Broman, P. C. Henning and J. L. McIntire, all of Wilmington.

Capital Increases, Etc.

THE FEDERAL CHEMICAL CO., Woodstock, Ill, has filed notice of increase in capital from $10,000 to $50,000.

DUNLOP AMERICA, LTD., River Road, Buffalo, N. Y., manufacturer of tires and rubber goods, has filed notice of change of name to the Dunlop Tire & Rubber Corporation of America.

THE JUNE CHEMICAL WORKS, INC., Wilkes-Barre, Pa., has filed notice of increase in capital from $100,000 to $250,000.

THE FISK RUBBER CO., Chicopee Falls, Mass., has arranged for a bond issue of $10,000,000, following a merger with the Federal Rubber Co., Cudahy, Wis., and the Ninigret Co., Westerly, R. I.

THE UNITED STATES ASBESTOS CO. OF ILLINOIS, Chicago, has filed notice of increase in capital from $25,000 to $75,000.

THE CORTLAND GRINDING WHEEL CORP., Cortland, N. Y., has filed notice of dissolution under state laws.

THE ROSEVILLE POTTERY CO., an Ohio corporation, has filed notice of organization to operate in New York. M. T. Scott, 621 Fifth Ave., is representative.

THE WATSON-FITZGERALD CO., Danville, Va., manufacturer of bricks and other burned clay products, is arranging for an increase in capital to $150,000.

THE APEX CHEMICAL CO., a New York corporation, has filed notice to operate in New Jersey for the manufacture of chemical products. The company is represented by H. Nelson Craig, 200 South First St., Elizabeth, N. J.

THE RIVER RAISIN PAPER CO., Monroe, Mich., has arranged for a bond issue of $2,200,000.

Manufacturers' Catalogs

THE JEFFREY MANUFACTURING CO., Columbus, O., calls attention to Catalog 350, on Jeffrey conveying machinery, which contains illustrations, price lists and dimensions of Jeffrey chains, sprockets, conveyor and elevator details, transmission and gears.

THE ALDRICH PUMP CO., Allentown, Pa., has issued a 16-page catalog on Aldrich pumps.

THE PARKS-CRAMER CO., Fitchburg, Mass., has issued an attractive booklet on "Fluid Heat Transmission by the Merrill Process."

THE PACIFIC FOUNDRY CO., San Francisco, Cal., calls attention to a new catalog on "Corrosiron." Products made from Corrosiron, which is a high-silicon alloy, such as pipe and fittings, valves, plug cocks, plunger pumps, centrifugal pumps, etc., are illustrated and described. Specifications are also given. The physical properties are given, as well as information about the machining of Corrosiron, designs and patterns, casting, together with general information on areas and circumferences of circles, density of liquids, metric equivalents of feet and inches, conversion factors, and weights and measures.

PAWLING & HARNISCHFEGER CO., Milwaukee, Wis., has just issued Pamphlet TX which describes and illustrates the new Skimmer Boom designed for attachment to the standard P & H 205 or 206 Excavator-Crane. The point is made that by replacing the standard boom of either of these cranes, an efficient road-grading machine is provided. In fact, this is similar to the Shovel Attachmnet brought out earlier this year and which is designed for use with either of the two types of P & H cranes mentioned. Data and operating cost figures on a road grading job done by William Datka, contractor, are included, together with a profile for the road, prepared by the county highway department.

THE MALCOLMSON BRIQUET ENGINEERING CO. has consolidated with the St. Louis Briquette Machine Co. under the corporate name of the Malcolmson Engineering & Machine Corp. This company acts as engineer and contractor for the building of complete plants for fuel, fuel briquetting, peat harvesting, low-temperature distillation of fuels, preparation of phosphate rock and for the drying, crushing and screening of coal and rock products. The officers of the new company are C. T. Malcolmson, president; G. Komarek, vice-president; C. E. House, secretary, and W. J. Monahan, treasurer. Offices are in the Old Colony Bldg., Chicago, Ill.

THE CALCO CHEMICAL CO., Bound Brook, N. J., has prepared some interesting data and maps showing the condition of the coal-tar dye industry in the United States in 1914 as compared with that of 1920. In 1914 there were only seven small plants in three states, employing 528 men. In 1920 there were 82 dye plants located in eighteen states, the largest employing about 4,000 men. There were also 213 coal-tar chemical plants located in twenty-five states. These conditions are cited by the Calco Chemical Co. as evidence against the presumption of a monopoly of the American dye industry.

THE PETROLEUM TRUST REFINERY, with offices in Chicago, Ill., has begun operations at the former plant of the Seven States Oil Co., Hollywood Ave., Memphis, Tenn. The plant is now running at a capacity of 800 bbl. per day, which will be increased by the end of the summer to 6,000 bbl. per day. Crude oil is being shipped in from the fields at Eldorado. B. W. Franklin is general superintendent of the Memphis plant.

THE NIAGARA RADIATOR & BAR CO., Chicago, has purchased 10 acres at the southwest corner of 83d St. and Woodlawn Ave., and is laying plans for the erection of a new foundry 140 x 175 ft. Later a 4-story warehouse will be built, making the total expenditure involved about $250,000.

New Publications

BOOKS

SILICA AND THE SILICATES. By *James A. Audley*. Pp. 374; 27 illustrations. New York: D. Van Nostrand Co., 1921. Price, $4.50.

This volume of the series on Industrial Chemistry edited by Dr. Samuel Rideal describes the silicate industries and their raw materials in the following order: silica, the many forms in which it occurs in nature; silicates and other compounds containing silica; lime, mortar and cement; the ceramic industries; glass and enamels; miscellaneous applications of silicates—alum, slag fertilizers, soils, earthy and other silicate pigments.

TECHNICAL METHODS OF ANALYSIS. Edited by *Roger Castle Griffin*, director of analytical department, Arthur D. Little, Inc. Pp. 666; 29 illustrations. New York: McGraw-Hill Book Co., Inc., 1921. Price, $6.

Analytical methods which have been adopted as standard procedures in the laboratories of Arthur D. Little, Inc., have been brought together in classified form. The book covers a wide range of technical products and is supplemented by an excellent bibliography. The methods are grouped under the headings: Reagents; general inorganic analyses; general organic analyses; analysis of metals; fuels; paints and paint materials; oils, fats, waxes and soaps; wood, paper and paper-making chemicals; textiles and textile fibers; foodstuffs; miscellaneous—leather, rubber, case-hardening and cutting compounds, water, boiler scale, fertilizers, pitches, tars, cement and concrete, etc.

FAMOUS CHEMISTS: THE MEN AND THEIR WORK. By *Sir William A. Tilden, F.R.S., D.Sc., LL.D.*, professor emeritus of chemistry in the Imperial College of Science and Technology. Pp. 296, illustrated. New York: E. P. Dutton & Co., 1921. Price, $5.

"Among those who have supplied indispensable links in the chain of events which has culminated in the present state of knowledge in chemistry there are but few whose names are known even among well-educated people. And yet the story of their lives is full of interest and instruction for all who care about the progress of science.

"The present volume is an attempt to sketch, in a style suitable for general reading, the lives of some of the most prominent chemists of the past. As it is obviously impossible for one person to deal with them all, the first great difficulty in such a project is to make the selection. After much reflection the guiding principle adopted is the evolution of the atomic theory from the point of view of the chemist.

"The first question is, Who is to be included? A crowd of names comes at once into the mind and each man seems entitled to be called a 'great chemist'; but of those who have not been included it will be found, I believe, that however important their contribution to science their discoveries have not been indispensable along the line indicated. No disrespect is intended to any of them, but the necessity for limitation imposes a restraint which it would be easier to disregard than to comply with."

Thus the evolution of the atomic theory is traced in the lives of twenty-one chemists: Boyle, Black, Priestley, Cavendish, Scheele, Lavoisier, Davy, Dalton, Gay-Lussac, Proust, Berzelius, Faraday, Avogadro, Cannizzaro, Liebig, Dumas, Frankland, Williamson, Mendeleeff, Crookes, Ramsay.

PHYSICAL CHEMISTRY FOR COLLEGES. By *E. B. Millard*, assistant professor of physical chemistry, Massachusetts Institute of Technology. Pp. 411; 61 illustrations. New York: McGraw-Hill Book Co., Inc., 1921. Price, $3.50.

The more important topics of physical chemistry are treated at such length as the size of the volume allows and numerous references to recent periodical literature are included for those who would pursue any given topic further. The limitations of the orthodox laws of physical chemistry are emphasized more than is commonly done in beginning courses of physical chemistry, since it is felt that a wholesome appreciation of physical chemistry as an unfinished and growing science may stimulate thoughtfulness and research.

A TEXTBOOK OF INORGANIC CHEMISTRY FOR COLLEGES. By *James F. Norris*, professor of organic chemistry, Massachusetts Institute of Technology. Pp. 677; 45 illustrations. New York: McGraw-Hill Book Co., Inc., 1921. Price, $3.50.

The subject matter is presented in a form which can be reasonably well followed by the student through private study and with the smallest amount of explanation on the part of the teacher. The subject is developed slowly and the consideration of the more abstruse material has been deferred until the student has gained some familiarity with chemical phenomena and with the language of the science.

AMERICA'S POWER RESOURCES. By *Chester G. Gilbert* and *Joseph E. Pogue*. Pp. 326; 37 illustrations. New York: The Century Co., 1921. Price, $2.50.

This book is an attempt to interpret the special, though generally unrecognized, importance attaching to the energy resources—coal, oil, natural gas and water power; and to point to the shortcomings in the way they are handled, to which a considerable measure of our current economic difficulties is traceable. The attempt is also made to outline the changes in energy administration that are bound to come into play, if due social and industrial progress is to be attained, and to indicate the avenues of advance to which constructive efforts need to be applied. The material presented is largely the result of investigations carried on by the authors in the Smithsonian Institution, in the Fuel Administration, and in a somewhat diversified engineering practice, and brought out from time to time as special papers, emanating mostly from the Division of Mineral Technology, United States National Museum. These special contributions have attracted such notice that it seemed desirable to weld the results into this unified and less technical form for wider and more popular presentation.

AMERICAN CHEMISTRY. By *Harrison Hale, Ph.D.*, head of department of chemistry, University of Arkansas. Pp. 215; 63 illustrations. New York: D. Van Nostrand Co., 1921. Price, $2.

A popular treatment of the chemical industries which should be useful to the general reader and to the student as collateral reading with a course in general chemistry. The illustrations are excellent and should help the student in visualizing plant operations. References at the end of each chapter encourage further study of topics in which special interest has been aroused.

ORGANIC COMPOUNDS OF MERCURY. By *Frank C. Whitmore, Ph.D.*, professor of organic chemistry, Northwestern University. Pp. 397. New York: The Chemical Catalog Co., Inc., 1921. Price, $4.50.

The total amount of work which has been done on organic mercury compounds is probably greater than that done on the organic arsenicals, but it has received much less publicity. Although a number of monographs have been written in English and in German on the arsenic compounds, this is the first which has appeared in any language on the mercurials. It is number three in the American Chemical Society's series of scientific and technologic monographs.

THE WORKING OF STEEL. By *Fred H. Colvin*, editor, *American Machinist*, and *K. A. Juthe*, chief engineer, American Metallurgical Corporation. Pp. 245; 125 illustrations. New York: McGraw-Hill Book Co., Inc., 1921. Price, $3.

A practical discussion of the annealing, heat-treating and hardening of carbon and alloy steel.

PHILOSOPHY AND THE NEW PHYSICS. By *Louis Rougier*, translated by Morton Masius, professor of physics, Worcester Polytechnic Institute. Pp. 159. Philadelphia: P. Blakiston's Son & Co., 1921. Price, $1.75.

An essay on the relativity theory and the theory of quanta.

STATISTICAL ABSTRACT OF THE UNITED STATES, 1920. Pp. 874. Washington: Superintendent of Documents, Government Printing Office. Price, 50c., paper covers.

THE SILVER BROMIDE GRAIN OF PHOTOGRAPHIC EMULSIONS. By *A. P. H. Trivelli* and *S. E. Sheppard*. Pp. 143, illustrated. New York: D. Van Nostrand Co., 1921. Price, $2.50.

This is the first of a series of monographs on the theory of photography from the research laboratory of the Eastman Kodak Co., edited by Dr. C. E. Kenneth Mees and Mrs. Mildred S. Schramm. It presents the results of a complete crystallographic study of the grains of high-speed emulsions which showed that all the grains belong to the same crystalline class and that consequently their formation in the emulsion could be studied in the light of von Weimarn's dispersion theory.

PAMPHLETS

THE ENGINEER AND THE UNIVERSITY. New York: Columbia University, 1921.

An interesting and attractive presentation of the engineer's status in industry, of the problems involved in his education and of what the School of Mines, Engineering and Chemistry of Columbia University has to offer toward the solution of these problems.

INTERFACIAL TENSION MEASUREMENTS AND SOME APPLICATIONS TO FLOTATION. By *Robert B. Elder*. Pamphlet No. 1, Bureau of Mines and Geology, State of Idaho, published in co-operation with the U. S. Bureau of Mines. Moscow: University of Idaho, 1921.

A mathematical consideration of the Du Nouy and Fahrenwald methods for measuring surface tensions and their application to flotation problems.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its seventy-fourth meeting at Toronto, Canada, Dec. 27 to 31, 1921.

AMERICAN CERAMIC SOCIETY will hold its twenty-first annual meeting at St. Louis, Feb. 27 to March 2, 1922.

AMERICAN GAS ASSOCIATION will hold its third annual convention in the Congress and Auditorium Hotels, Chicago, the week of Nov. 7. More than 100 manufacturers will exhibit their latest gas-burning appliances.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting at Lake Placid, N. Y., Sept. 29 and 30, and Oct. 1.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its annual winter meeting at Baltimore, Md., Dec. 6 to 9. Headquarters will be at the Southern Hotel and the sessions will be held in the Engineers' Club.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN SOCIETY FOR STEEL TREATING is holding its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

NATIONAL SAFETY COUNCIL will hold its tenth annual conference at the State House, Boston, Mass., Sept. 26 to 30.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer and will resume them in October.

SOCIETY OF INDUSTRIAL ENGINEERS will hold its fall meeting at Springfield, Mass., Oct. 5 to 7.

The following meetings are scheduled to be held in Rumford Hall, the Chemists' Club, New York: Oct. 7—American Chemical Society, regular meeting; Oct. 14—Société de Chimie Industrielle, regular meeting; Oct. 21—Society of Chemical Industry, Grasselli Medal; Nov. 11—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting; Nov. 18—American Electrochemical Society, regular meeting; Dec. 2—Society of Chemical Industry, regular meeting; Dec. 9—American Chemical Society, regular meeting.